CCGPS Frameworks Student Edition

Mathematics

Fourth Grade Unit Seven
Measurement

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"Making Education Work for All Georgians"

Unit 7

MEASUREMENT

TABLE OF CONTENTS

OVERVIEW

In this unit students will:

- investigate what it means to measure length, weight, volume, time, and angles
- understand how to use standardized tools to measure length, weight, 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 (1/2, ¼, 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.
- Recognize angles as geometric shapes that are formed wherever 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.

To assure that this unit is taught with the appropriate emphasis, depth, and rigor, it is important that the tasks listed under "Evidence of Learning" be reviewed early in the planning process. A variety of resources should be utilized to supplement this framework unit. The tasks in these units illustrate the types of learning activities that should be utilized from a variety of sources.

STANDARDS FOR MATHEMATICAL CONTENT

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

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

MCC4.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.

MCC4.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.

Represent and interpret data.
MCC4.MD.4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions 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.
A line plot shows the "shape" of the data and provides the foundation for future data concepts, such as mode and range.

Geometric Measurement - understand concepts of angle and measure angles.
MCC4.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.

MCC4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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.

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

ENDURING UNDERSTANDINGS

- 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.
- Know relative sizes of measurement units within one system including km, m, cm; kg, g; lb, oz; l, ml; hr, min, and sec.
- Know and apply the formula for area (l x w) and express the answer in square units.
- Know and apply the formula for perimeter: $2l + 2w$ or $2(l + w)$ and express the answer in linear units.
- 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.
- Use collected data to solve problems involving addition or subtraction of fractions.

ESSENTIAL QUESTIONS

- About how heavy is a kilogram?
- Can different size containers have the same capacity?
- Does 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 of linear measurement within a standard system 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 are units in the same system of measurement related?
- How can angles be combined to create other angles?
- How can fluid ounces, cups, pints, quarts, and gallons be used to measure capacity?
- How can we estimate and measure capacity?
- How can we measure angles using wedges of a circle?
- How can we use angle measures to draw reflex angles?
- 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 find the area of a rectangle?
- How do we find the perimeter of a rectangle?
- How do we make a line plot to display a data set?
- How do we measure an angle using a protractor?
- How do we measure volume?
- How do we use weight measurement?
- How does a circle help with 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?
- How is a circle like a ruler?
- How is perimeter different from area?
- How will we interpret a set of data?
- What are benchmark angles and how can they be useful in estimating angle measures?
- What around us weighs about a gram?
- What around us weights about a kilogram?
- What connection can you make between the volumes of geometric solids?
- What do we actually measure when we measure an angle?
- What do we know about the measurement of angles in a triangle?
- What do you do if a unit is too heavy to measure an item?
- What does half rotation and full rotation mean?
- What happens to a measurement when we change units?
- What is a unit?
- What is an angle?
- What is the difference between a gram and a kilogram?
- 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?

- What is weight?
- What material is the best to use when measuring capacity?
- What material is the best to use when measuring volume?
- What should you do if a unit is too heavy to measure an item?
- What units are appropriate to measure weight?
- When do we use conversion of units?
- When should we measure with grams? Kilograms?
- Why are standard units important?
- Why are units important in measurement?
- Why do we measure weight?
- 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?
- Why is it important to be able to measure weight?

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 lengths.

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.

Definitions for these and other terms can be found on the Intermath website, a great resource for teachers. Because Intermath is geared towards middle and high school, grade 3-5 students should be directed to specific information and activities.
http://intermath.coe.uga.edu/dictnary/homepg.asp
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
- weight
- yard (yd)
- data
- line plot
- acute angle
- angle
- arc
- circle
- degree
- measure
- obtuse angle
- one-degree angle
- protractor
- reflex angle

- right angle
- straight angle
- intersect

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 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.

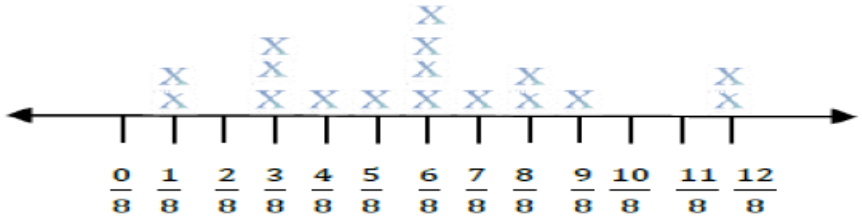
Present problems that involve multiplication of a fraction by a whole number (denominators are 2, 3, 4, 5 6, 8, 10, 12 and 100). Problems involving addition and subtraction of fractions should have the same denominators. Allow students to use strategies learned with these concepts.

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.

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 ($^1/_2$,$^1/_4$,$^1/_8$) and plot data showing multiple data points for each fraction.



Pose questions that students may answer, such as

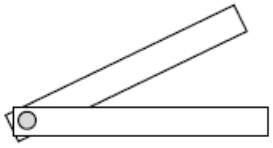
- "How many one-eighths are shown on the line plot?" Expect "two one-eighths" as the answer. Then ask, "What is the total of these two one-eighths?" Encourage students to count the fractional numbers as they would with whole-number counting, but using the fraction name.
- "What is the total number of inches for insects measuring $^{3}/_{8}$ 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 $^{1}/_{8}$ inch or $^{5}/_{8}$ inches?" Have students write number sentences to represent the problem and solution such as, $^{1}/_{8} + {}^{1}/_{8} + {}^{5}/_{8} = {}^{7}/_{8}$ 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 includes self-assessment and reflection.

EVIDENCE OF LEARNING

By the conclusion of this unit, students should be able to demonstrate the following competencies:

- Measure weight of an object using an appropriate unit (ounce, pound, gram, kilogram)
- Measure angles using a protractor
- Estimate weight and angle measure
- Know some familiar referents for various weight units
- Understand that the sum of the angles in any triangle is 180°
- Understand half and full rotation
- Solve problems involving the measurement and conversion of hour, minute, second, centimeter, meter, kilometer, gram, inch, foot, yard, gram, kilogram, ounce, pound, milliliter, liter, fluid ounce, cup, pint, quart, and gallon.
- Solve problems involving the area and perimeter of rectangles by applying formulas.
- Make a line plot to display a data set of measurements in fractions of a unit (to 1/8)

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 a performance task, they also may be used for teaching and learning.

Scaffolding Task	Constructing Task	Practice Task	Performance Tasks
Tasks that build up to the constructing task. Allows teachers to see the progression (why and how).	Constructing understanding through deep/rich contextualized problem solving tasks.	Games/activities	Summative assessments for the unit.

Task Name	Task Type/ Grouping Strategy	Content Addressed
Measuring Mania	Constructing Task *Individual/Small Group Task*	Measure ½, ¼, and 1/8 inch sections on ruler
What's the Story?	Performance Task *Individual/Partner Task*	Make a line plot to display data to 1/8 inch
Perimeter and Area	Constructing Task *Individual/Partner*	Determine area and perimeter
Setting the Standard	Scaffolding Task *Small Group Task*	Understand and use a standard unit of measure (gram)
Worth the Weight	Scaffolding Task *Small Group Task*	Estimate and weigh items using grams and kilograms
A Pound of What?	Constructing Task *Small Group Task*	Understand and use pound as a measure of weight
Exploring an Ounce	Constructing Task *Small Group Task*	Understand and use an ounce as a measure of weight
Too Heavy? Too Light?	Constructing Task *Individual/Partner Task*	Problem solving that requires unit conversion within the same system
Capacity Line-Up	Scaffolding Task *Partner/Small group*	Estimate and measure metric capacity
More Punch Please!	Constructing Task *Individual/Partner task*	Measure capacity using customary units; Convert liquid measures within the customary system
Water Balloon Fun!	Constructing Task *Individual/Partner Task*	Measure capacity using metric and customary 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

Task Name	Task Type/ Grouping Strategy	Skills
Which Wedge is Right?	Scaffolding Task *Partner task*	Use non-standard units to measure angles
Angle Tangle	Scaffolding Task *Individual/Partner task*	Use a 360° circle; Identify and use benchmark angles
Build an Angle Ruler	Scaffolding Task *Individual/Partner task*	Build and use an angle ruler
Guess My Angle!	Constructing Task *Whole group/Partner task*	Measure angles using a protractor
Turn, Turn, Turn	Constructing Task *Whole group task*	Use rotation to find angles
Summing It Up	Constructing Task *Individual/Partner task*	Explore the angle measures of a triangle
Culminating Task: Angles of Set Squares	Performance Task *Individual/Partner Task*	Combine shapes to make angles; Find measure of unknown angle of a triangle

Constructing Task: Measuring Mania

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; L, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...*

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

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 yard sticks. Students should notice that it takes fewer yard sticks 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?
- Why are units important in measurement?

MATERIALS

- ruler
- colored pencils, markers, or crayons

GROUPING

Individual

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

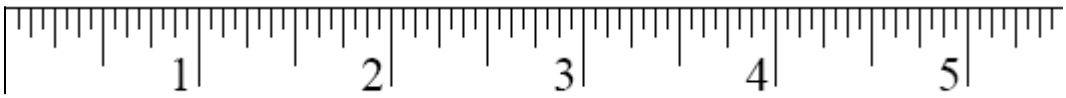
In this task, students will develop a deeper understanding of linear measurement. Students will measure lengths to the nearest one-half, one-fourth, and one-eighth of an inch and explore their relationships. Teachers should support good student dialogue and take advantage of comments and questions to 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 ½ inch if starting from **any** of the hash marks on a ruler? What about ¼ inch or 1/8 inch?

DIFFERENTIATION

Extension

- Students can be challenged to measure assorted objects provided in the classroom to the nearest 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 ¼ inch and ½ inch.

Intervention

- Have students create a paper ruler displaying the measurements with only 1/8 inch increments. This may eliminate the confusion of the 1/16 inch lines. Students can also create a paper ruler displaying only ¼ or ½ inch increments.

Name_____ Date_____

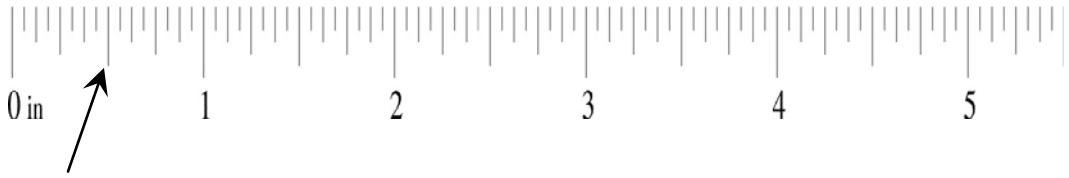
Measuring Mania Recording Sheet

1. Show all ½ inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.

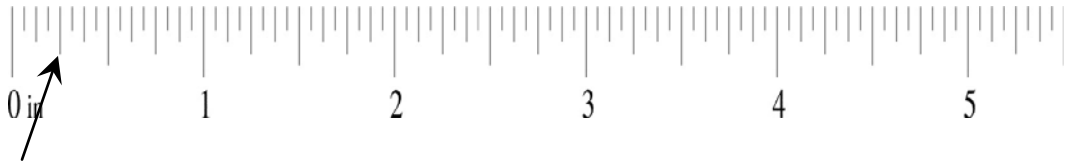
2. Show all ¼ inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.

3. Show all 1/8 inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.

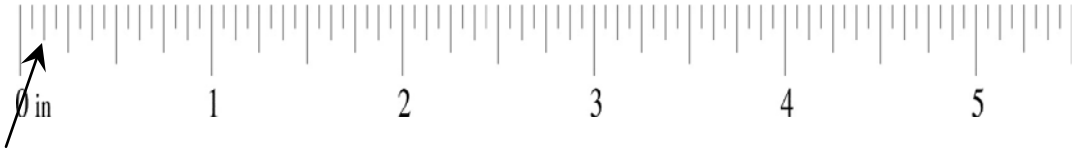
4. Show all ½ inch increments. Start at the arrow and highlight each increment with a contrasting color.



5. Show all ¼ inch increments. Start at the arrow and highlight each increment with a contrasting color.



6. Show all 1/8 inch increments. Start at the arrow and highlight each increment with a contrasting color.



Performance Task: What's the Story?

STANDARDS FOR MATHEMATICAL CONTENT

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MCC4.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.

MCC4.MD.4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions 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

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.
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8. Look for and express regularity in repeated reasoning.

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. The data presented above are most appropriate for a bar graph or circle graph. 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 are data collected?
- How do we determine the most appropriate graph to use to display the data?
- How will we interpret a set of data?
- 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

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: 1/8, 1/8, 2/8, 2/8, 3/8, 3/8, 3/8, 3/8, 3/8, 4/8, 4/8, 5/8, 5/8, 5/8, 5/8, 6/8, 6/8, 7/8, 7/8, 7/8, 7/8, 8/8, 8/8, 8/8, and 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&m's checking for the number of red in each set. The first sample we took had 7 reds out of 8 m&m's or 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 7/8 of an inch. After the second 3 days (the second sample), I noticed it grew 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?
- Are there other interpretations you can make from your line plot?
- Have you labeled your line plot appropriately?

DIFFERENTIATION

Extension

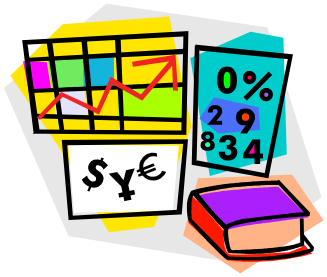
- Have students repeat the activity using data that they collect.
- Have students display their data in an appropriate graph.
- Have students research and describe situations in which data are collected and displayed routinely.

Intervention

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

Name _____ Date _____

What's the Story?



Using the set of data below:

- 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 interpretations from the given set of data

Data:

Sample	1	2	3	4	5	6	7	8	9	10	11	12
Length (in)	7/8	3/8	6/8	5/8	8/8	2/8	5/8	3/8	7/8	1/8	4/8	8/8

Sample	13	14	15	16	17	18	19	20	21	22	23	24	25
Length (in)	1/8	7/8	3/8	4/8	8/8	2/8	5/8	3/8	8/8	7/8	5/8	3/8	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._____

Constructing Task: Area and Perimeter

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

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

MCC4MD.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.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

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 ¼ inch grid paper (grid provided has 0.3 inch squares)

GROUPING

Individual or partner task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Task Directions
Part 1:

1. Instruct students to draw a rectangle with a perimeter measuring 12 units. (Use 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 of 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. Ask about anything they notice about the relationship between the area and perimeter.
4. Direct the 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.

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 start 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 for the students to determine the dimensions, perimeter, and area. Students should record their findings and sketch each rectangle on the centimeter grid paper.

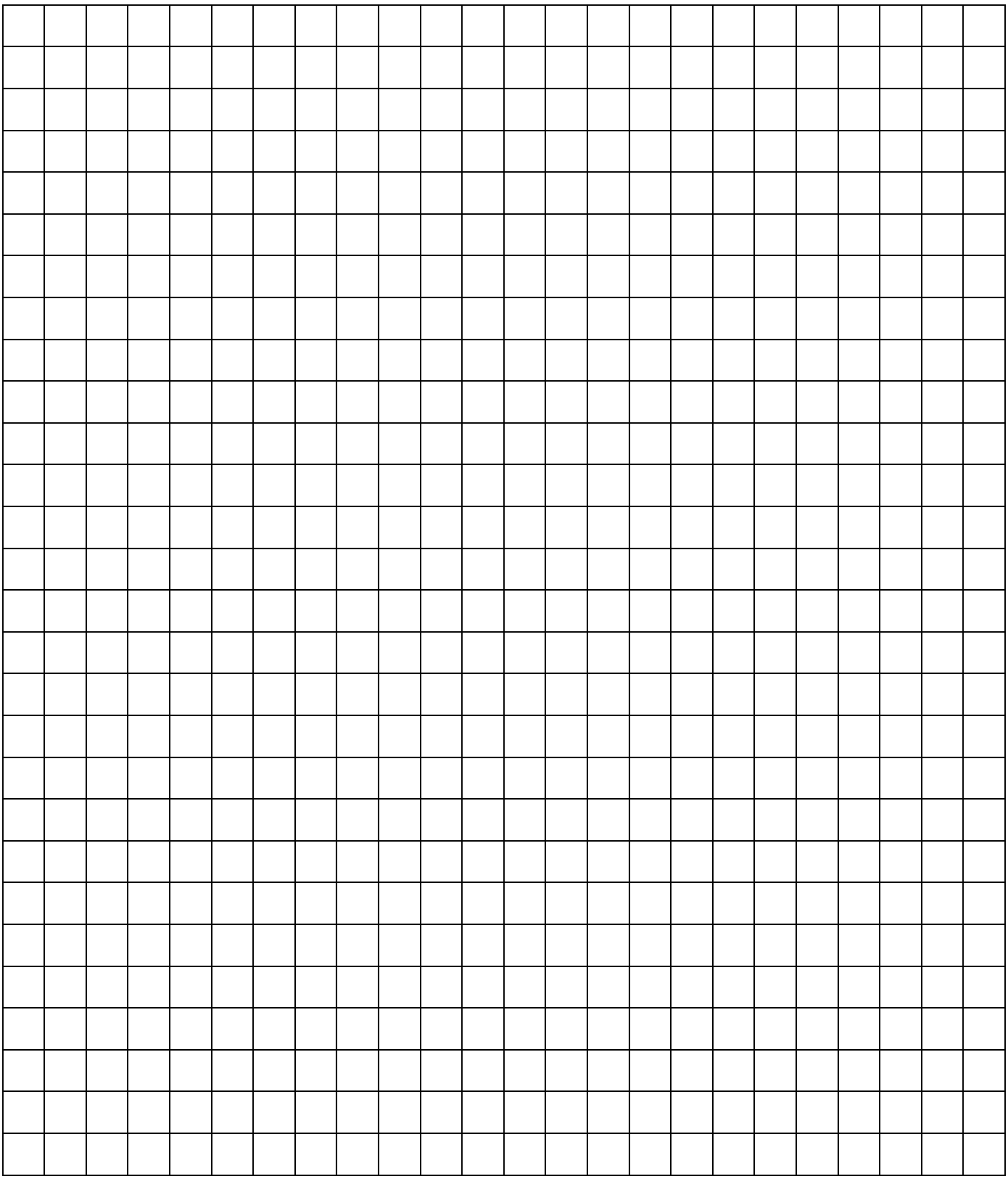
Name_____ Date _____

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 _____

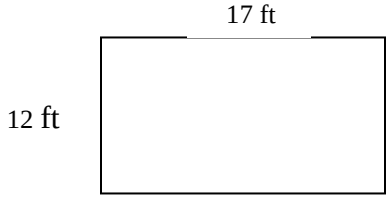
Perimeter and Area: Part 2

Solve the following problems.

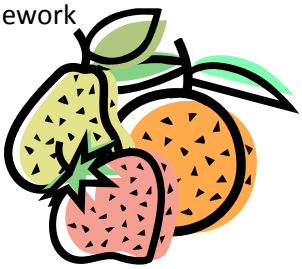
1. The community center has decided to move the parking area to the back of the building and replace the front with a grass lawn. The lawn is rectangular shaped with a length of 10 yards and a width of 40 yards. A bag of grass seed covers 50 square yards at a cost of $4.99 per bag.
   What is the total area of the new lawn?
   How many bags of grass seed will they need to buy?
   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?



Scaffolding Task: Setting the Standard

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

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

Students should know how to measure mass using a balance.

Students should have had experience measuring and comparing weight using a balance scale and understand the difference between standard and non-standard units in 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 the difference between a gram and a kilogram?
- What is weight (mass when using a balance)?

- Why do we measure weight?
- What units are appropriate to measure weight?
- What around us weighs about a gram?
- How are units in the same system of measurement related?
- 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

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 weight 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.) The correct term for this task is mass because students are using a balance scale.

Comments

To introduce this task, show a gram weight. Introduce its name and symbol and describe it as a standard unit of weight. 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 weight 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 how much this new unit weighs (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 weight of each object using 1 gram (1 g) weights.
2. Record the weights 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 weight of each piece of fruit and record it in your chart. Students may weigh 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 weight of an object?
- What happens when the unit is too small to measure an object?
- What is the difference between units in the same system of measurement?

DIFFERENTIATION

Extension

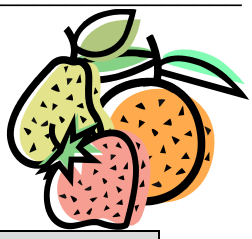
- Ask students to find the weight of the objects using different units, such as hectograms and dekagrams.
- Ask students to estimate how many apples would be needed to make one kilogram? How many bananas? How many oranges?

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.

Name _____ Date _____

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.

_____

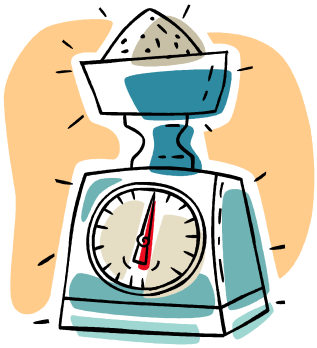
_____

_____

_____

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: Worth the Weight



STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

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

Students need to be familiar with the terms gram and kilogram, 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 and is equal to about 2.2 pounds.

ESSENTIAL QUESTIONS

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

MATERIALS

- "Worth the Weight, Part 1 – Grams" student recording sheet
- "Worth the Weight, Part 2 – Kilograms" student recording sheet
- Large paper clip
- Gram weight
- Balance
- 1 kg reference weights
- Spring scales

GROUPING

Small Group Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

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

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 weigh about one kilogram. Alternatively, fill bags with sand, aquarium gravel, or dried beans. Students can use these "reference weights" to compare weights when looking for items that weigh one kilogram.

Part 1

To introduce this part of the task, hold up a large paper clip and explain that it weighs 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 weigh using grams. Ask students to record their items in the table on their student recording sheet, "Worth the Weight, Part 1 – Grams."

For each item on their chart, students should hold the item to estimate its weight first, 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 are appropriate to weigh 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 weight (more than, less than, or about 1 kilogram), 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 are appropriate to weigh 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 "Worth the Weight, Part 1 - Grams" student recording sheet.

Think about how heavy a paper clip is. Now find five objects that you think should be weighed 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.
- 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 grams? Be ready to share your thinking with the class.

Part 2

Students will follow the directions below from the "Worth the Weight, 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 how heavy one kilogram is. Then find items around the room that weigh 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. Weigh each item with a spring scale.
4. Record the weight 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 weight?
- When would you use grams and kilograms in your everyday life?
- What are your predictions for which objects will weigh about a gram? Why?
- What are your predictions for which objects will weigh 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 how much each item weighs.

- Have students estimate how many kilograms five different people weigh (family members, neighbors, friends, babysitters, etc.).

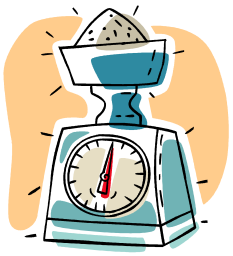
Intervention

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

Name _____ Date _____

Worth the Weight

Part 1 - Grams



Think about how heavy a paper clip is. Now find five objects that you think should be weighed 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.
- Weigh each item using the scale provided and record it in the chart below.

Object	Estimated Weight (g)	Actual Weight (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?

_____

_____

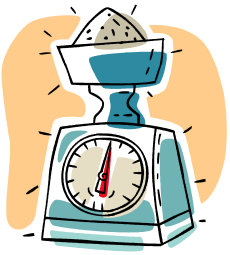
_____

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

Name _____ Date _____

Worth the Weight

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 how heavy one kilogram is. Then find items around the room that weigh 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. Weigh each item with a spring scale.
4. Record the weight in the last column.

Remember: 1 kg = 1,000 grams

Object	**Prediction** (check the correct box below)			**Actual Weight (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?

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

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

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

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.
>
> Remember: 1 kg = 1,000 grams
>
> 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.

Name _____ Date _____

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.

- 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.

	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.

_____

_____

_____

Name _____ Date _____

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

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)*

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

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 do you do if a unit is too heavy to measure an item?
- 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

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 a weight measure ounce with a liquid measure 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.

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 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 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 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.

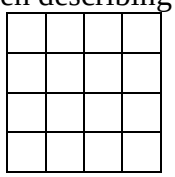
DIFFERENTIATION

Extension

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

Intervention

- Use 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).



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 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 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?

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)*

MCC4.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

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

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

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will add weights of different units but 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 (g or oz) 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 weigh the three presents he bought. Their weights 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. Can Kim go on to the final round?

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, have students use a drawing with labels to set up the problem. Step 2, have students convert. Step 3, have students solve.
- Before giving students who struggle this task, provide similar problems that been amended. An example is shown below. By eliminating information that is not important for the problem, students are able to focus on the mathematics.

Name _____ Date _____

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 weigh the three presents he bought. Their weights 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. Can Kim go on to the final round?

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

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

MCC4.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

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

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 yard sticks. Students should notice that it takes fewer yard sticks to measure the room than the number of rulers of 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 (be sure the graduated cylinders measure in milliliters (mL)
- 2 sheets construction paper
- Filler, such as sand, small beans, rice, water, etc.
- Tennis ball
- Apple

GROUPING

Partner/Small Group Task

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 similar text. The humorous story relates real-life objects to 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 with 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 changes and/or staying the same.

While comparing capacity is difficult, comparing volume is sometimes even harder. One method of comparing volume is displacement. To do this, use an apple and a tennis ball. Choose one container bigger than both items. Fill it completely with filler and then pour that into an empty holding container. Place the first object in the original container and fill it to the top with the filler. The remaining filler is equal to the volume of the object. Make a mark on the side of the holding container to show this amount. Repeat this with the second object. Compare the two marks to determine which object has a greater volume.

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 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) and 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 Cylinder" student recording sheet.

> Record your estimate of 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.

FORMATIVE ASSESSMENT QUESTIONS

- Does size and shape always affect capacity? Why or why not?
- How can you compare the volume of 2 similar items?
- How did you decide which 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.

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!

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

MCC4.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

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

Before students are given this task, they will need to be familiar with customary units of measure. 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).

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

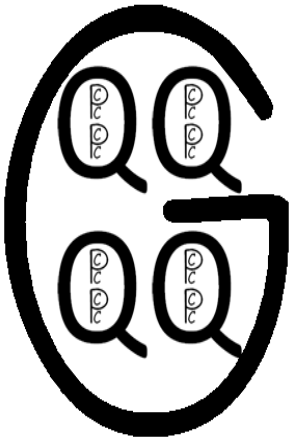
Individual/Partner Task

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 rice, small beans, sand, or 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:

   <u>Strawberry Sherbet</u>

   2 pints of Strawberry Sherbet $\times$ 7 = 14 pints of Strawberry Sherbet
   There are 8 pints in one gallon, 14 pints $\div$ 8 pints per gallon = 1 gallon and 6 pints.
   There are 2 pints in one quart, 6 pints $\div$ 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 gallons 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 rice, sand, or 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.

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

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!

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

MCC4.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

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

Before students are given this task, they will need to be familiar with customary and metric units of 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

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 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, rice, or sand 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 (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 1.5 liters of water to fill six water balloons. Each balloon holds 0.35 liter 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 filled all of his balloons with 2 quarts of water. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Whose balloons contain the most water?

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

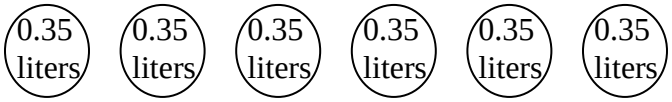
1,000 mL = 1 L

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 1.5 liters of water to fill six water balloons. Each balloon holds 0.35 liter of water. Does she have enough water to fill all six balloons? If not, how many balloons can she fill?**

Students could use a picture to solve this problem. To fill six balloons, Beverly would need 0.35 × 6 liters of water.



She would need a total of 0.35 liter × 6 = 2.1 liters of water. She only has 1.5 liters of water. She only has enough to fill 1.5 liters ÷ 0.35 liters or approximately 4.29 balloons.

So, Beverly can only fill 4 balloons with 1.5 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 filled all of his balloons with 2 quarts of water. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Whose balloons contain the most water?**

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, rice, or sand.
- 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.

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 1.5 liters of water to fill six water balloons. Each balloon holds 0.35 liter 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 filled all of his balloons with 2 quarts of water. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Whose balloons contain the most water?	

Unit 7 Culminating Task – Part 1

Performance Task: Dinner at the Zoo

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36)

MCC4.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.

MCC4MD.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.
8. Look for and express regularity in repeated reasoning.

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

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 like it is 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 383 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 ½ ton = 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 85 grams of food per kilogram of their body weight. That means a chimpanzee that weighs 15 kilograms needs 15 x 85 of food or 1,275 grams of food each day.
If, each chimpanzee needs 1,275 grams of food for each of the 30 days in April, then 1,275 x 30 = 38,250 grams of food is needed for one chimpanzee for the month of April. We have 10 chimpanzees each needing 38,250 grams of food for the month. Therefore, we'll need 10 x 38,250 or 382,500 grams of food. We know that there are 1,000 grams in 1 kilogram, so 382,500 ÷ 1,000 = 382.5 or rounded to the nearest whole number, 383 kilograms.

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 + $766 = $1,380.
If students bought the grain for the zebras by the bag only the total would be $384 + $250 + $766 = $1,400.

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 would 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 – $766
We will need 383 kilograms of food for the chimpanzees. If food costs $2 per kilogram, it will cost $2 x 383 = $766.

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 ½ ton and costs $50
A 50 pound bag of grain costs $8
A ton of grain costs $300

Chimpanzee Data
The chimpanzees weigh around 15 kg each.
Chimpanzees require 8 grams of food per day for every kilogram of their own weight.
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 97½ 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 36½ 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.

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
The chimpanzees weigh about 15 kg each.
Chimpanzees require 8 grams of food per day for every kilogram of their weight.
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?

.

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.

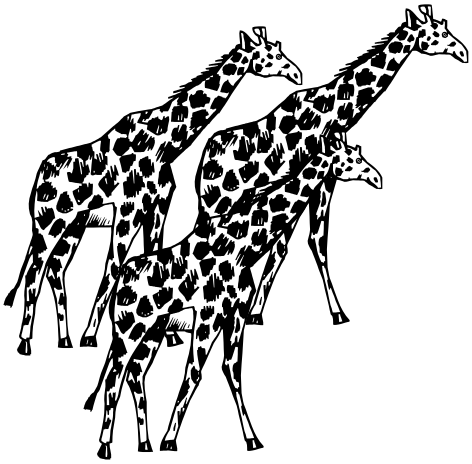
Design a barn with a stall for each zebra. Include space for a walkway and food storage. Sketch your design on the grid paper provided and record your measurements in the chart.

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.

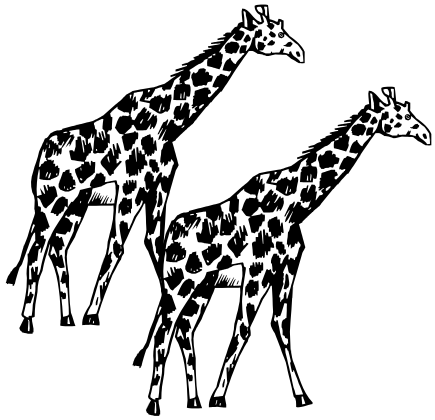
Giraffe: (each)

- 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?

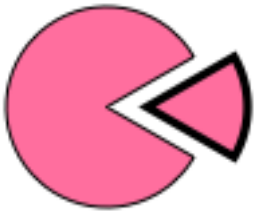
3. How many kilograms of fruit will the giraffes eat during the months of April and May?



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	31		

Scaffolding Task: Which Wedge is Right?



STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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

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

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 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

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 is the smallest?
    - Which angle do you think is the largest?
    - Can you order all of the angles from smallest to largest?
    - How did you decide the order?
    - Were some angles 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 a 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."

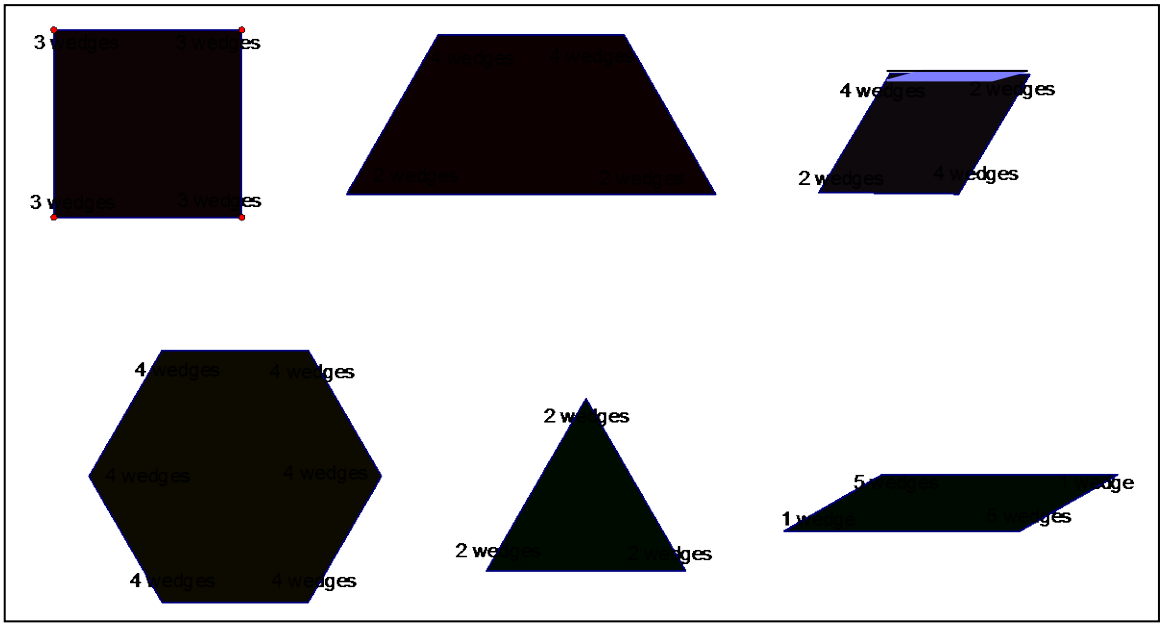
The students should realize the right angles are about 3 wedges and their measures should be more likely to agree with other students' measures because all wedges are the same measure. Allow time for the students to discuss their measures and any discrepancies they notice.

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 they all 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 they all 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

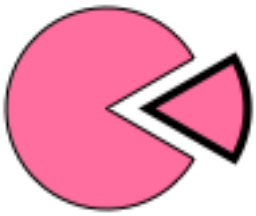
- Use larger angles drawn on paper and fraction circles for an easier manipulative.

- 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.

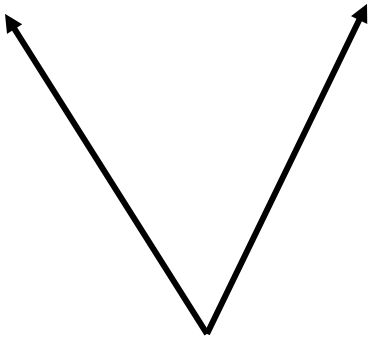
Name _____ Date _____

Which Wedge is Right?

Part 1 - Wedge Measures



1.



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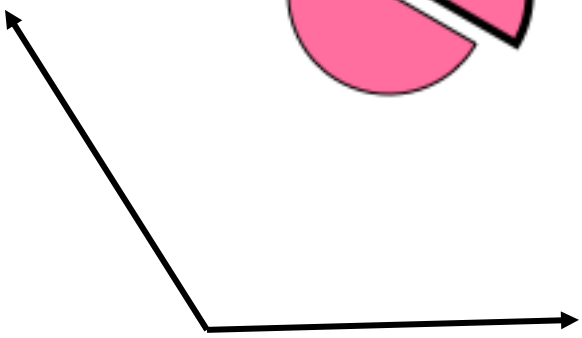

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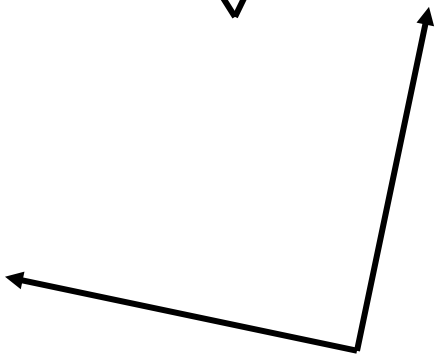

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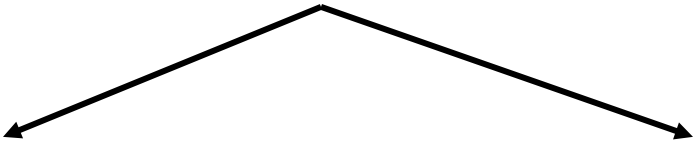

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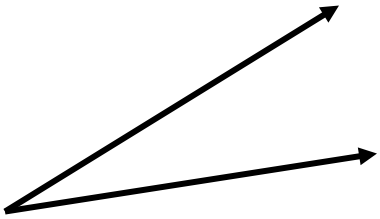

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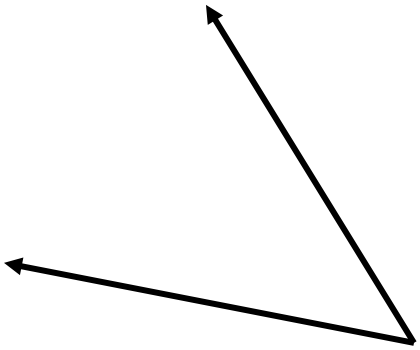
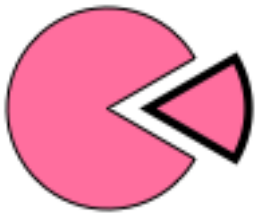


Angle	**How large is the angle?**	
	Your measure	Partner's measure
1.		
2.		
3.		
4.		
5.		
6.		

Name _____ Date _____

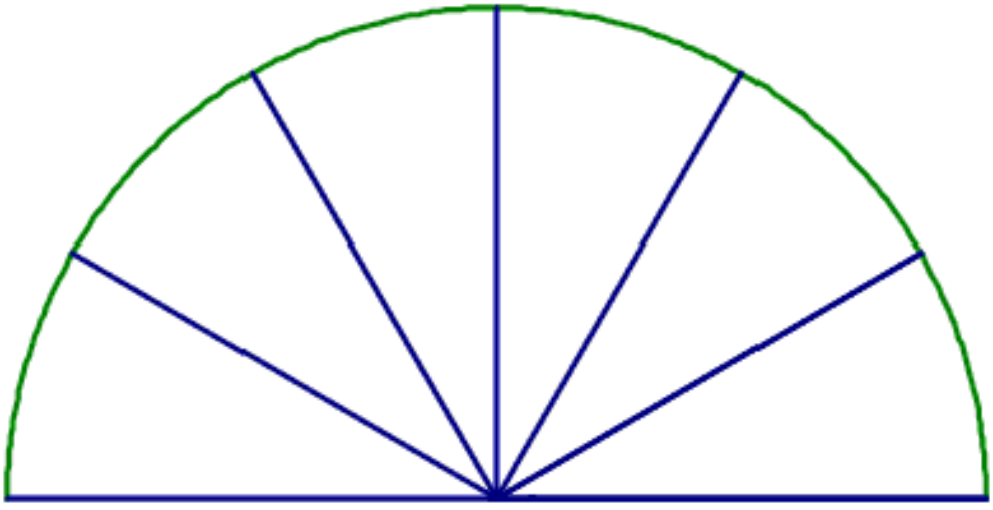
Which Wedge is Right?



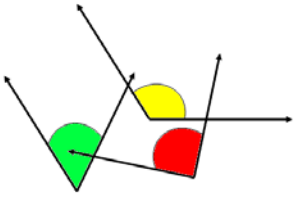
Part 2 – Equal Measure Wedges

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 the each pattern block.



Scaffolding Task: Angle Tangle



STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

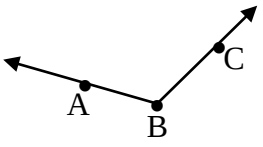
MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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

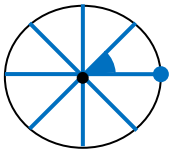
Students should be able to identify right, acute, and obtuse angles. Also, students should know how to name an angle using a point on each side with the vertex in the middle (i.e., ∠ABC, where A and C are a point on each ray, and B is the vertex of the angle.)



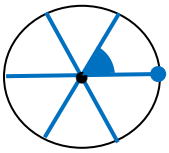
Benchmark angles, like benchmark numbers, are angles that are easy to work with and easy to identify. For example, 180° is half of 360°, making it a benchmark angle. Similarly, 90° is half of 180°, making it another benchmark angle. Finally, half of 90° is 45°, another benchmark angle. When thinking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

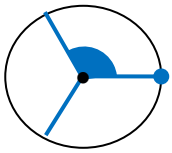
The student sheet with fractions of a circle with measures of 45 degrees, 60 degrees, and 120 degrees should look similar to the ones below.



45 degrees is1/8 of the circle



60 degrees is1/6 of the circle



120 degrees is1/6 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, 360^o 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

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will explore angles and their measurements using a 360^o 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 below 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 below. 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 1/3 fractional pieces are put together (240°) or when two 1/8 fractional pieces are put together (90°).

Task Directions

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

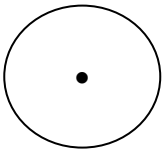
If "do a 360" means to make a complete circle, it makes sense that there are 360 degrees in a circle. You will be exploring the degrees in a circle and how that relates to angle measures. If a circle has 360 degrees, how many degrees are in ½ of a circle? You will be exploring that and the measures of other benchmark angles in this task.

Materials:

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

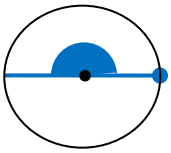
Directions:

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.



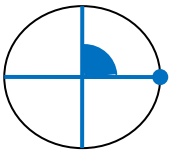
360 degrees is 1 whole circle

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 ÷ 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.

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.

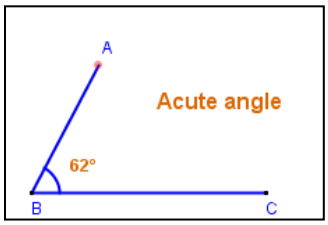
DIFFERENTIATION

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).

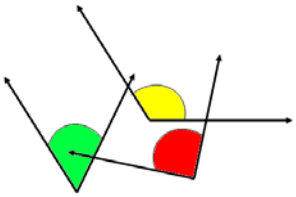
Intervention

- 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.

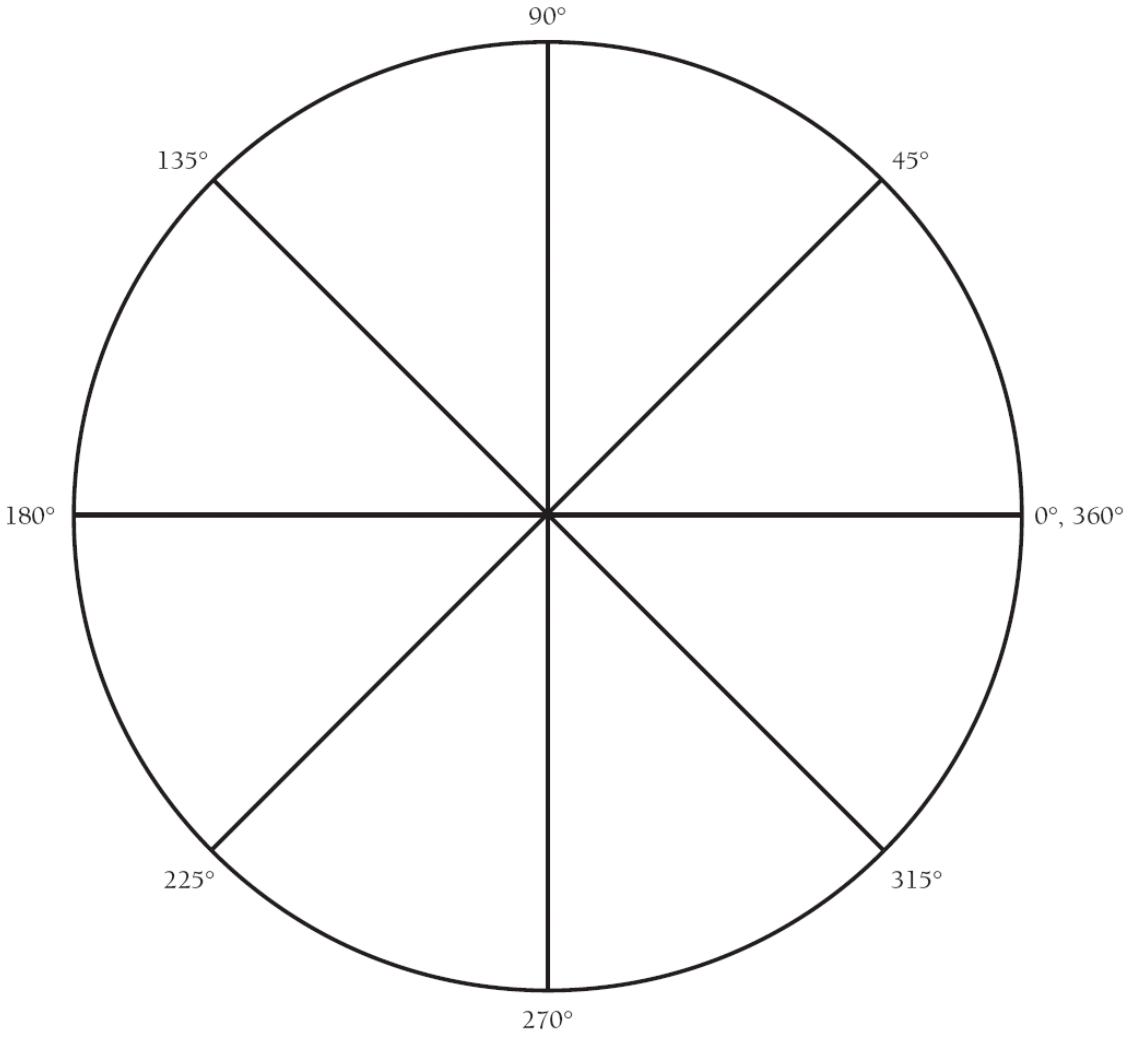


Name _____ Date _____

Angle Tangle



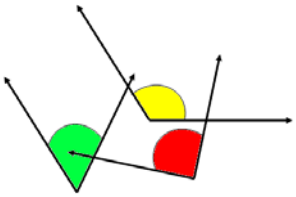
360° Circle



Name _____ Date _____

Angle Tangle

Fractions of a Circle



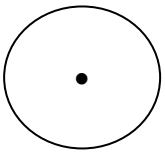
In skateboarding to do a "360" means to make a complete circle. This is because there are 360 degrees in a circle. You will be exploring the degrees in a circle and how that relates to angle measures. If a circle has 360 degrees, how many degrees are in ½ of a circle? You will be exploring that and the measures of other benchmark angles in this task.

Materials:

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

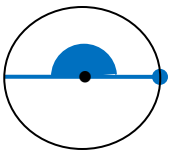
Directions:

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.



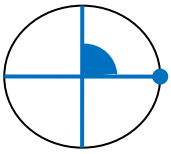
360 degrees is 1 whole circle

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 ÷ 2 = 180). Label your circle as shown.



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

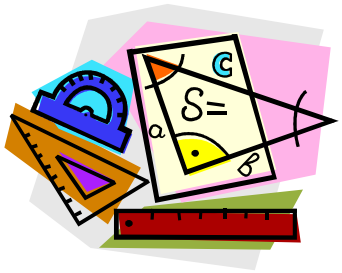
5. How much of the circle would have a measure of 90 degrees? (Think about how far you had to jump for a 90 degree turn.)
   How could you relate 90 degrees to a fraction of your circle?
   Find the fraction pieces that would make 90-degree angles. Label your circle as shown.



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



STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.
Use tools, such as a protractor or angle ruler, and other methods such as paper folding, drawing a diagonal in a square, to measure angles.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.
The primary concept is solving problems with adjacent angles.

STANDARDS FOR MATHEMATICAL PRACTICE

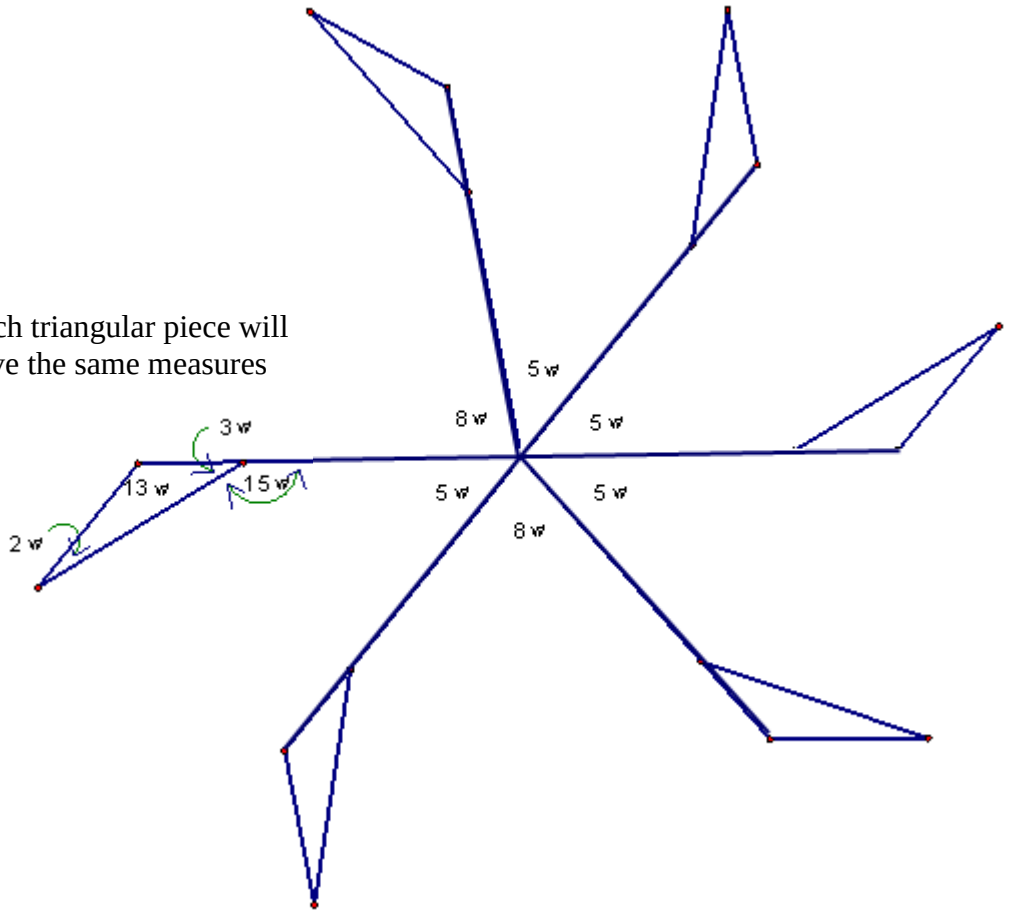
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look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

BACKGROUND KNOWLEDGE

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

Possible Solution

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



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

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.

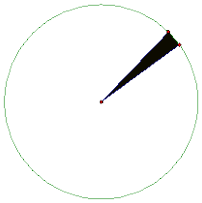
Make sure students are recording their angle measures in a way that allows them to communicate which angle has the indicated measure.

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.

Task Directions

Part 1

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

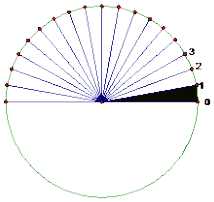


You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?

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.



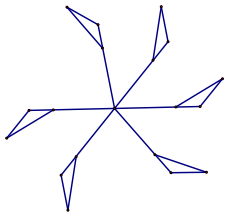
Discuss the following questions with your partner. Be prepared to share your thoughts with the class.

- How do you think it was created?
- What do the numbers represent?
- Fill in all 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

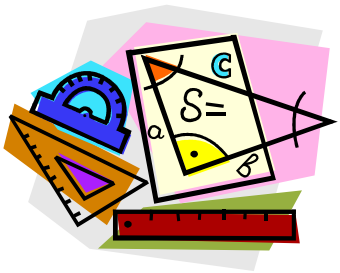
- Ask students to create their own design using an angle ruler. Have students share design and measure the angles contained within the design.

Intervention

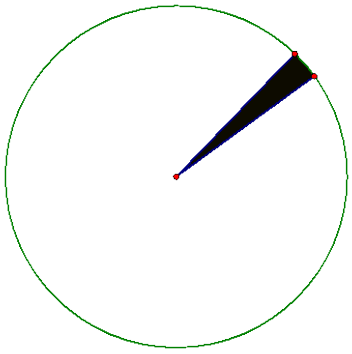
- Discuss possible angles to measure within the Rafe's design, being sure students are able to identify the vertex.

Name _____ Date _____

Build an Angle Ruler



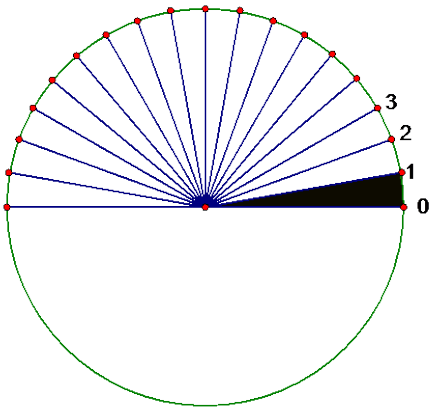
You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?



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

- 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.



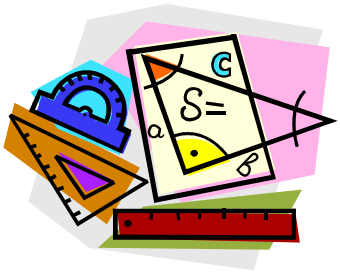
Discuss the following questions with your partner. On the back of this paper, record your answers to the questions. Be prepared to share your thoughts with the class.

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

Name _____ Date _____

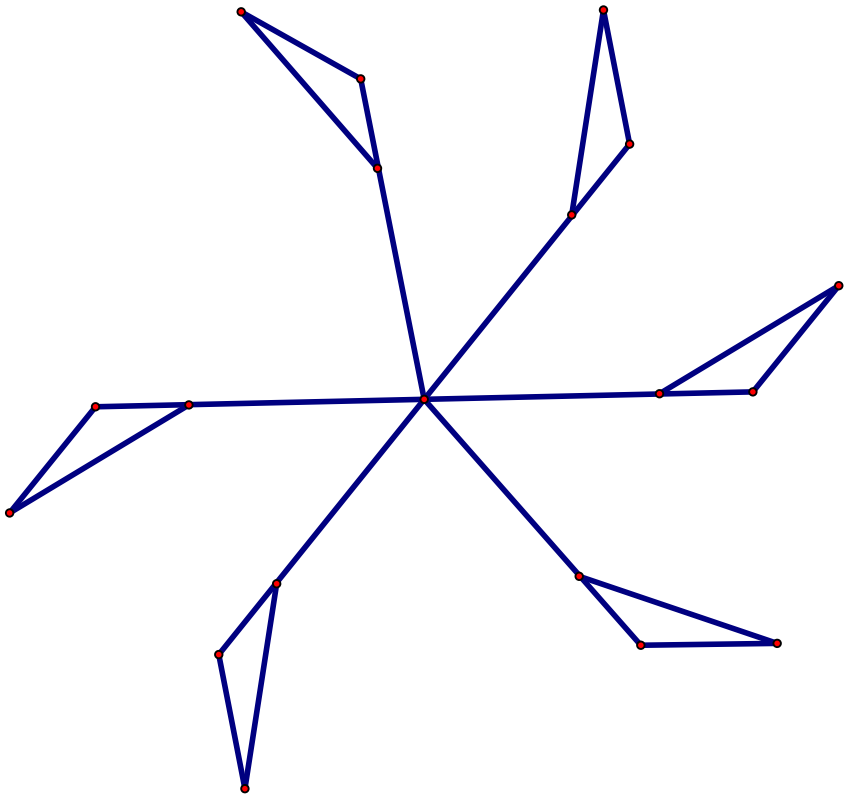
Build an Angle Ruler

Measuring Angles



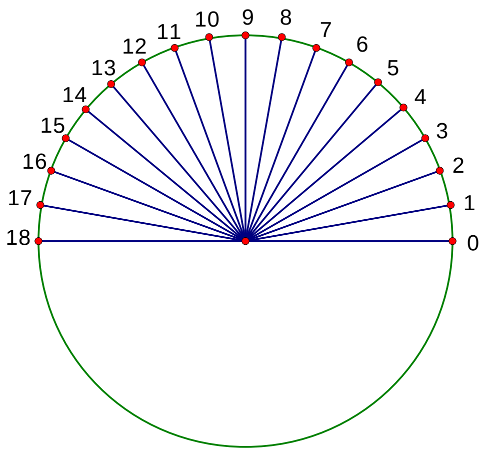
Rafe created the design below. What patterns do you notice in his design?

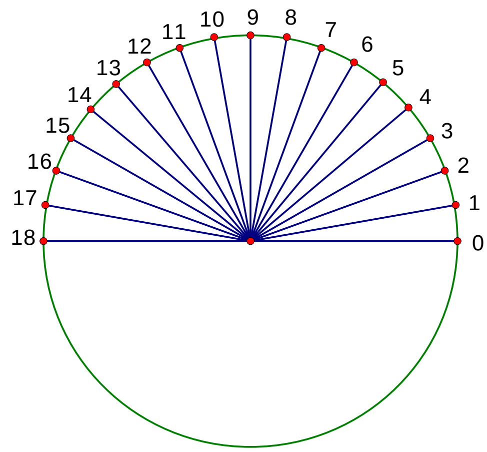
Your teacher has given you a copy of the "angle ruler" printed on a transparency sheet. Work with your partner and decide how to use your angle ruler to measure the different angles in Rafe's design. Try to find as many different angles as possible. Write the angle measure inside the angle.

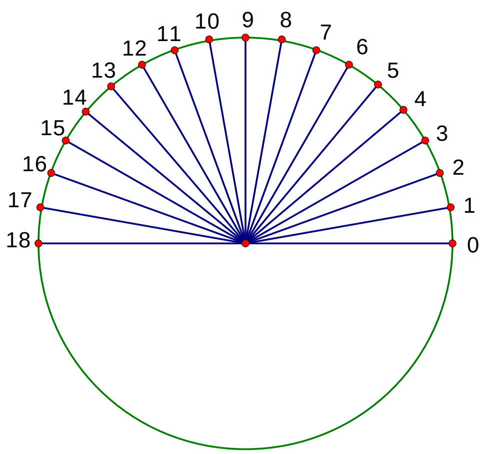


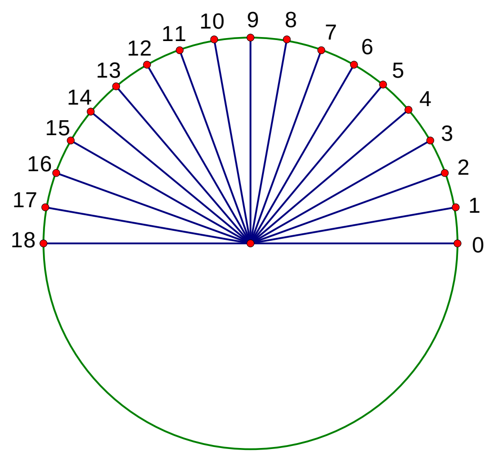
How do you think Rafe created this design?

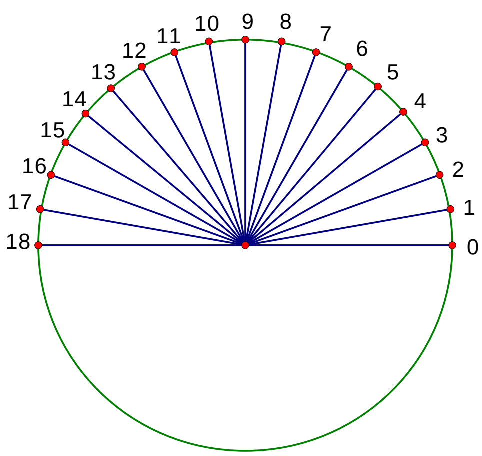
Angle rulers to copy onto transparencies:

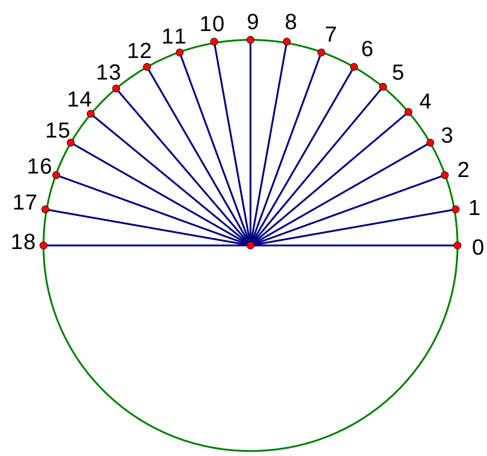












Constructing Task: Guess My Angle!

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

MCC4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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

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

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. 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 reading up to the answer.

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 do you take when using a protractor to measure an angle

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?"

Name _____ Date _____

Guess My Angle!

Materials:

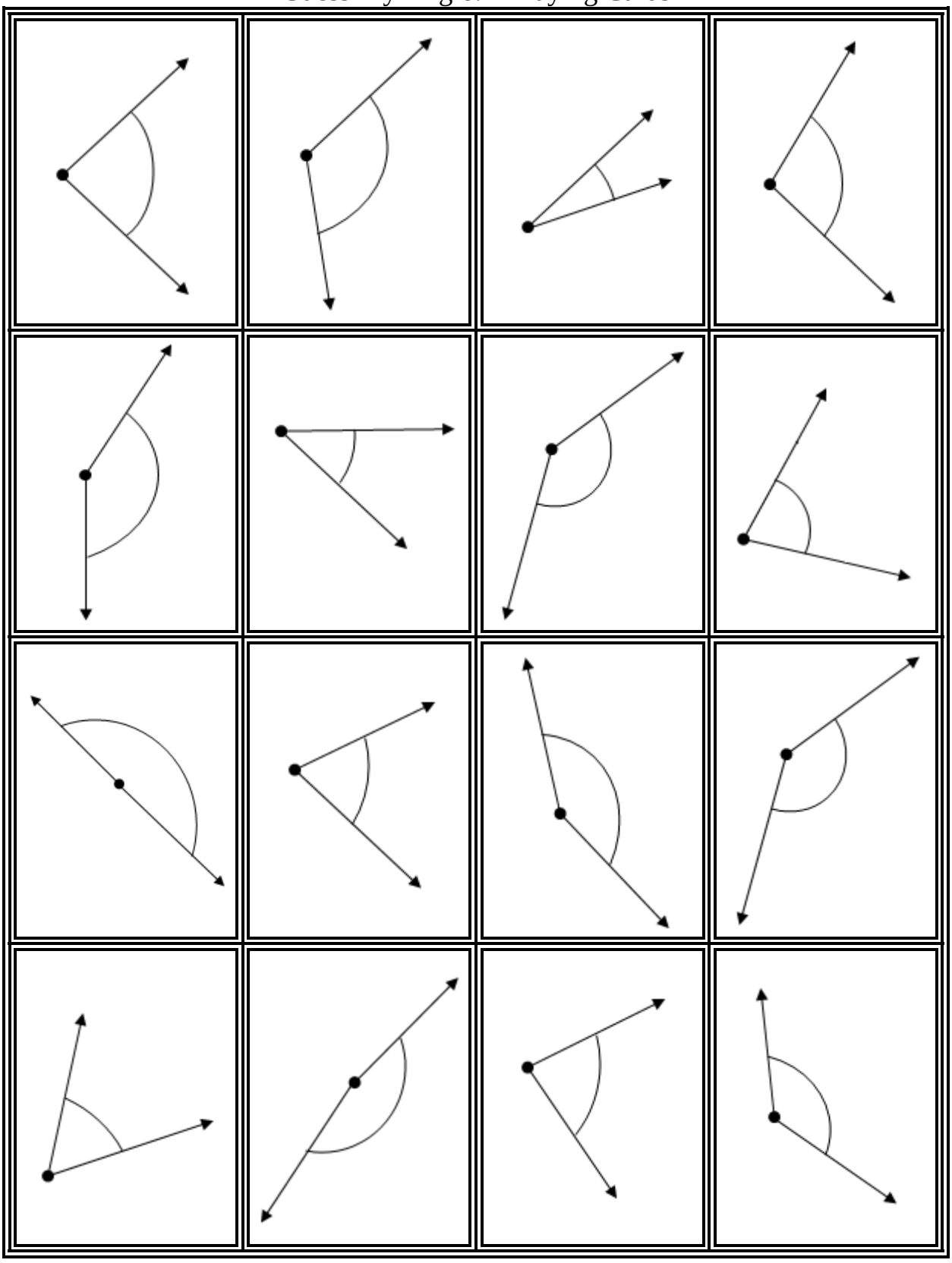
Deck of angle cards
Protractor for each player

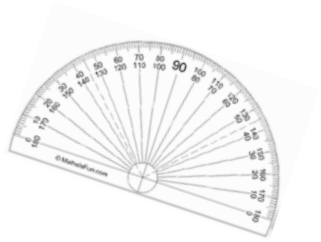
Directions:

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

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

MCC4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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

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

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 180 º? 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.

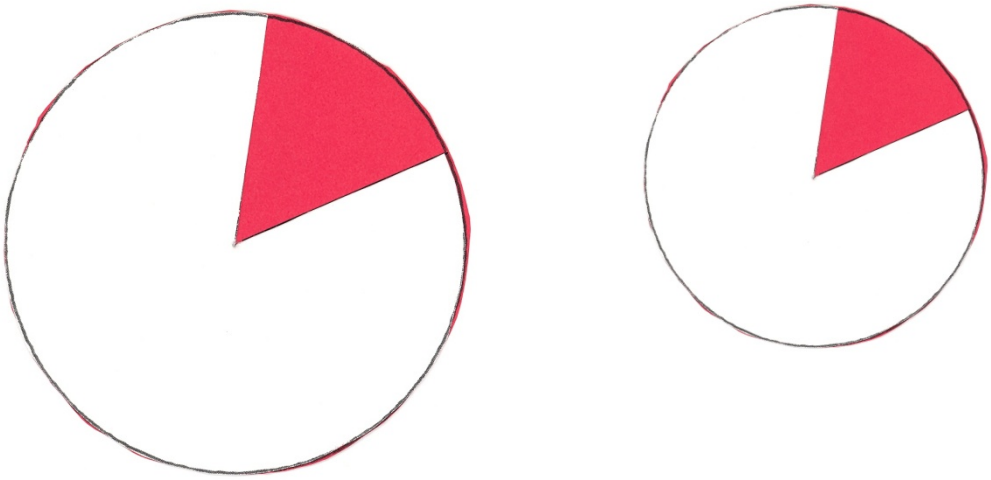
Encourage students to think of an angle as a turn or rotation. Have students make familiar angles (right, acute, obtuse). Then challenge them to make an angle that is the same as 3 right angles, an angle that has a right angle and an acute angle, etc.

Part 2

Students may have some common misconceptions about angle measurement. The activity below gives students another opportunity 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

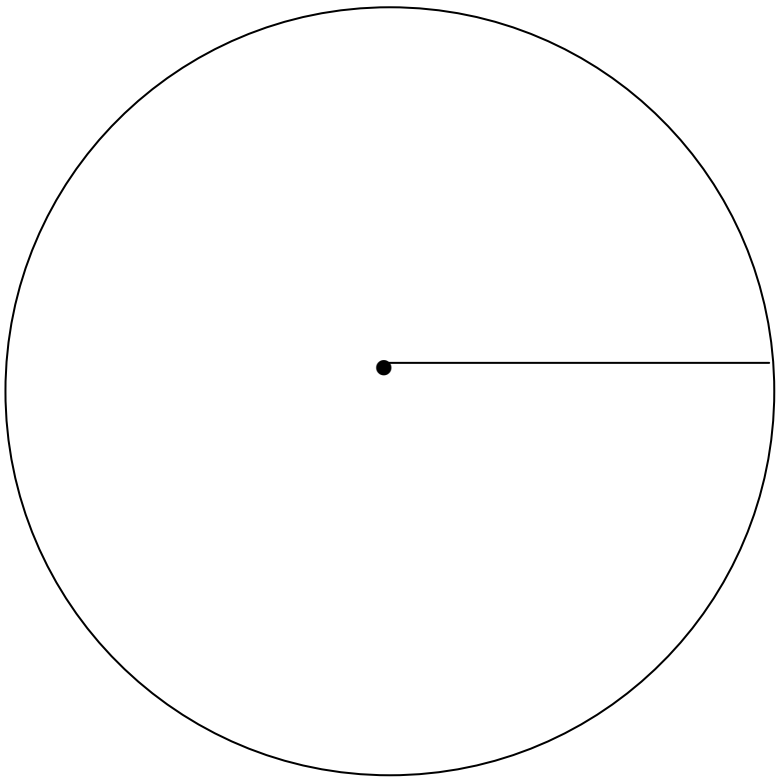
Extension

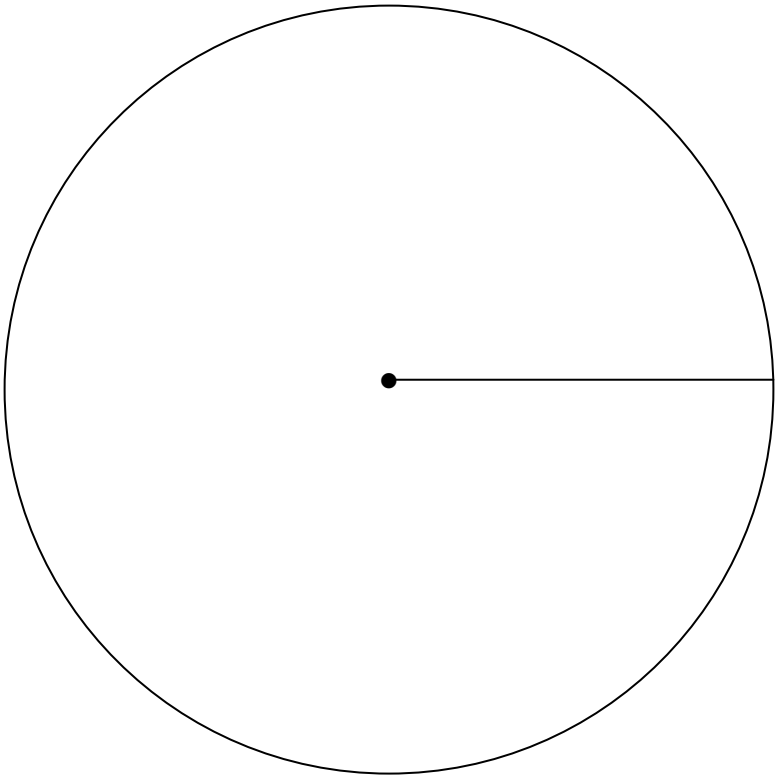
- Paste a copy of a protractor onto the back of one of the circles so the angle created by rotating the circle can be measured from the back of the set. Have one student create an angle while another child estimates the size of the angle. The first student can simply turn the circle around so students 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

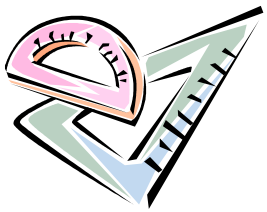
- Allow students to measure angles whose sides are long enough to measure comfortably with a protractor.
- Before students measure an angle, discuss the type of angle (acute, obtuse, right) so that the student uses the correct numbers to measure the angle.

Turn, Turn, Turn
Circles





Constructing Task: Summing It Up



STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

MCC4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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

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

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 CCGPS 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

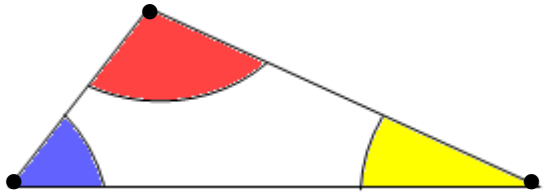
1. Using a straightedge, make a triangle on a separate piece of paper. Make your triangle big enough to easily measure each angle.
2. Measure each angle of the triangle using a protractor.
3. Write the measure of each angle inside the angle.

Find the sum of the measures of the angles.

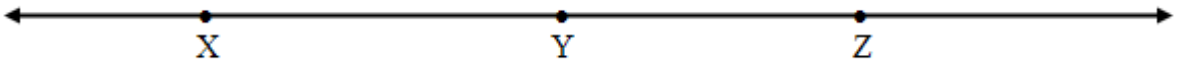
4. Record your sum on your paper and on the white board. **Sum of Angles_____**
5. Look at the class data on the white board. **What do you notice about the sum of the angle measures of triangles?**

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

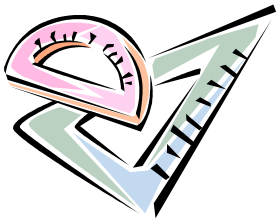
- Have students explore quadrilaterals in a manner similar to the way students explored triangles.
- To explore other shapes besides triangles and quadrilaterals, allow students to explore http://illuminations.nctm.org/ActivityDetail.aspx?ID=9.

Intervention

This task may be more manageable if done with a partner or in a small group with explicit teacher direction.

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?**

_____

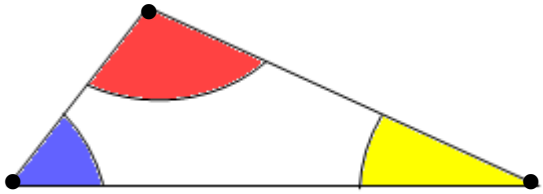
_____

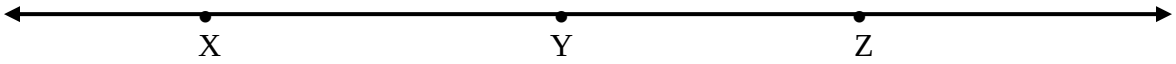
Part 2

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

STANDARDS FOR MATHEMATICAL CONTENT

MCC4.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.

MCC4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

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

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 of 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 (copied on cardstock)
- "Angles of Set Squares" student recording sheet
- "Angles of Set Squares, One Angle" student recording sheet (intervention)

GROUPING

Individual/Partner Task

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 dotted line.

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° = 120°; 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

Students will follow the directions below from the "Angles of Set Squares, Angle Measures" student recording sheet.

You will use the "set squares" below 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:

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 could you draw the reflex angle for this 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).

Name _____ Date _____

Angles of Set Squares

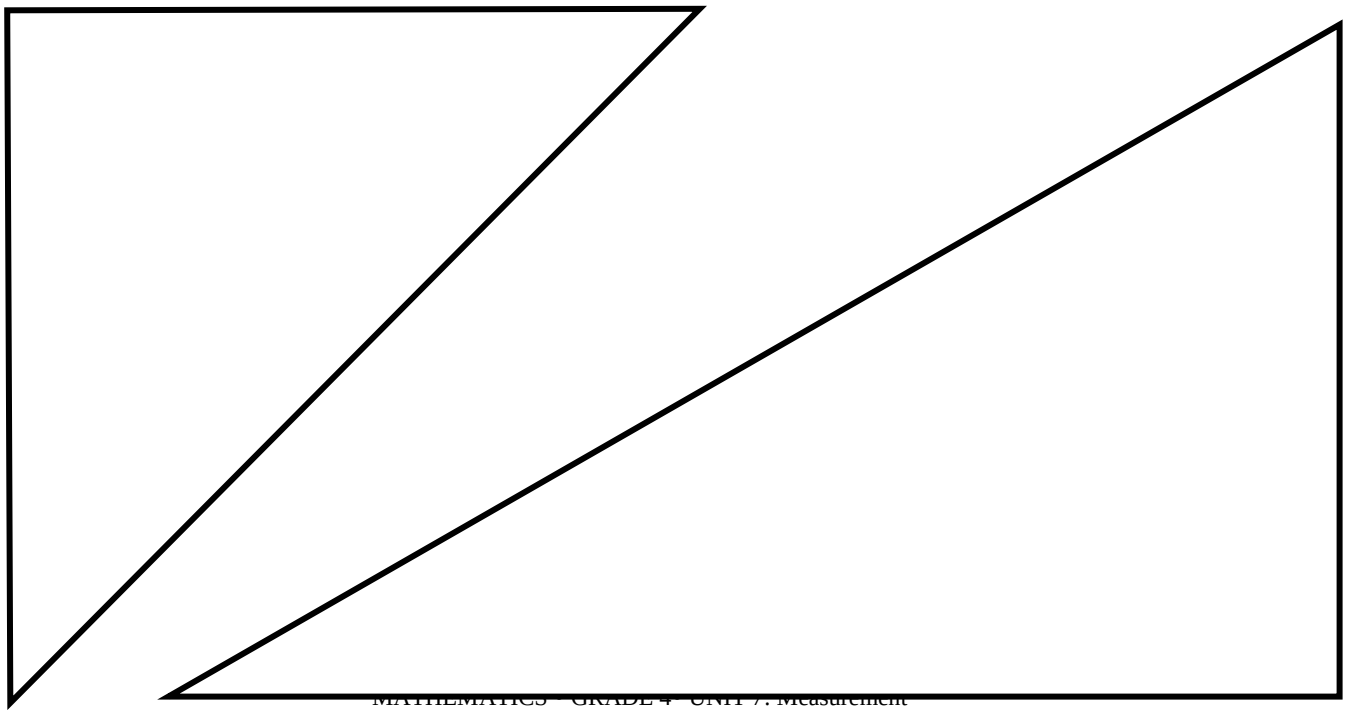
Angle Measures

You will use the "set squares" below 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.



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°