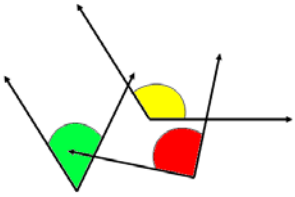
Scaffolding Task: Angle Tangle



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.

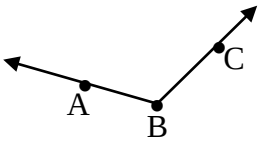
MCC4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g.,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

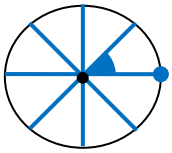
Students should be able to identify right, acute, and obtuse angles. Also, students should know how to name an angle using a point on each side with the vertex in the middle (i.e., ∠ABC, where A and C are a point on each ray, and B is the vertex of the angle.)



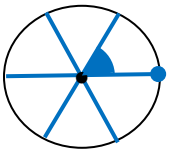
Benchmark angles, like benchmark numbers, are angles that are easy to work with and easy to identify. For example, 180° is half of 360°, making it a benchmark angle. Similarly, 90° is half of 180°, making it another benchmark angle. Finally, half of 90° is 45°, another benchmark angle. When thinking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

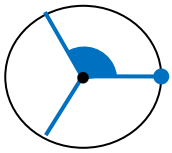
The student sheet with fractions of a circle with measures of 45 degrees, 60 degrees, and 120 degrees should look similar to the ones below.



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.

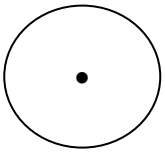
If "do a 360" means to make a complete circle, it makes sense that there are 360 degrees in a circle. You will be exploring the degrees in a circle and how that relates to angle measures. If a circle has 360 degrees, how many degrees are in ½ of a circle? You will be exploring that and the measures of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

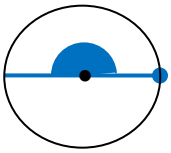
Directions:

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.



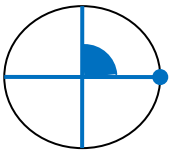
360 degrees is 1 whole circle

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.

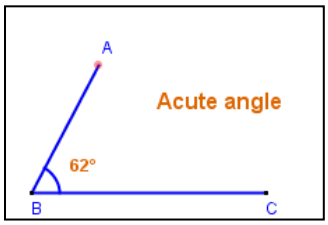
DIFFERENTIATION

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.



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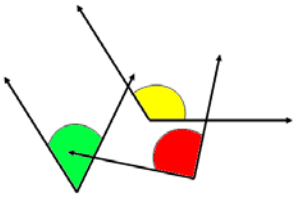
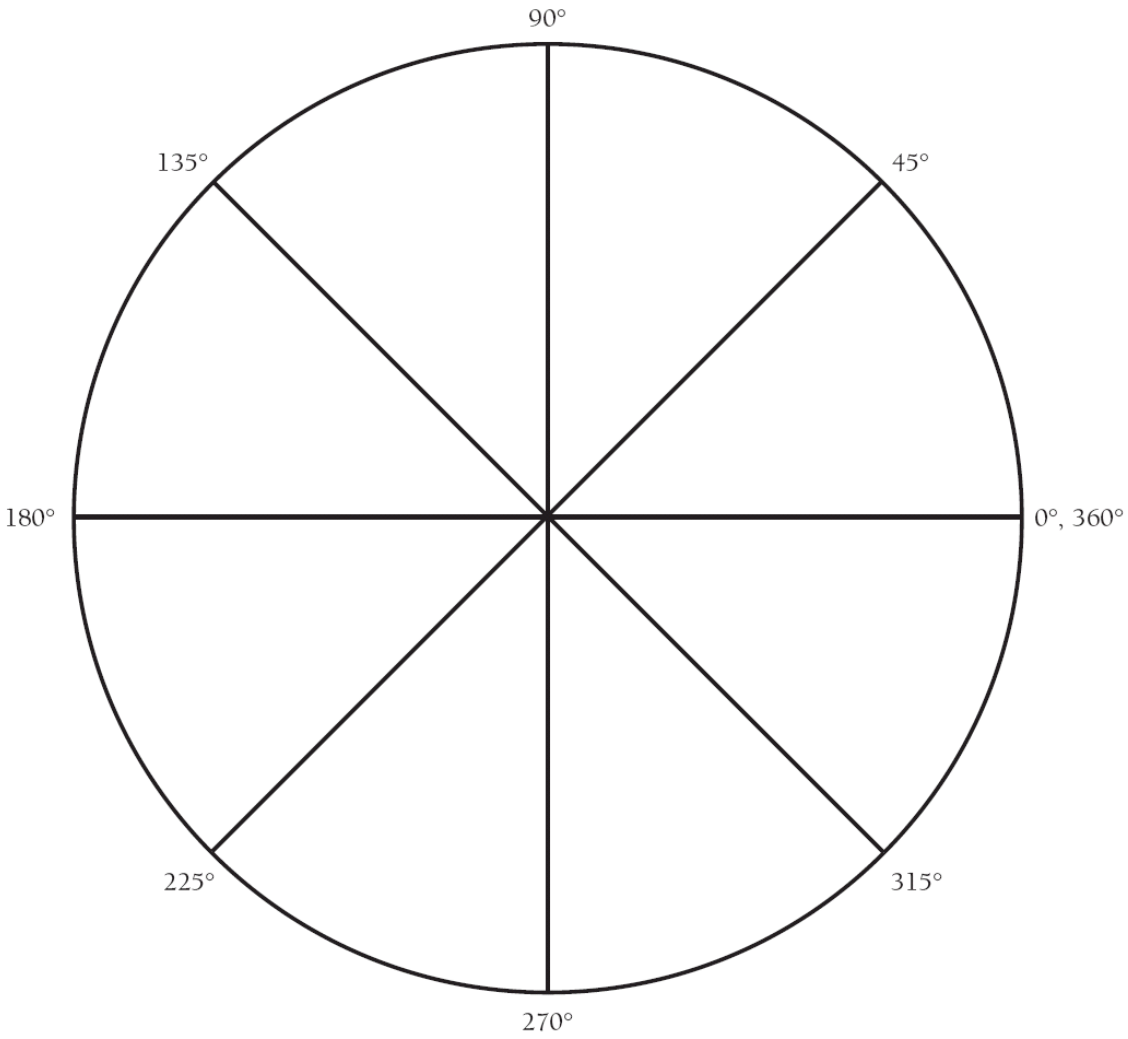
Angle Tangle



360° Circle



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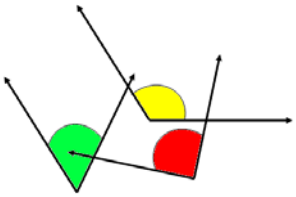
Angle Tangle

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.

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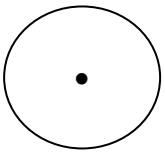

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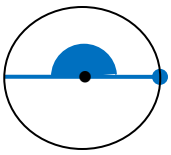

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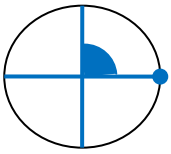

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