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