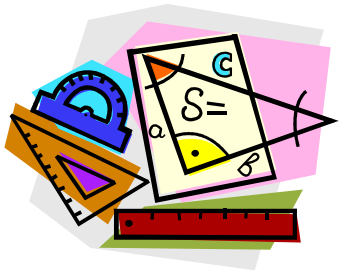
Scaffolding Task: Build an Angle Ruler



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

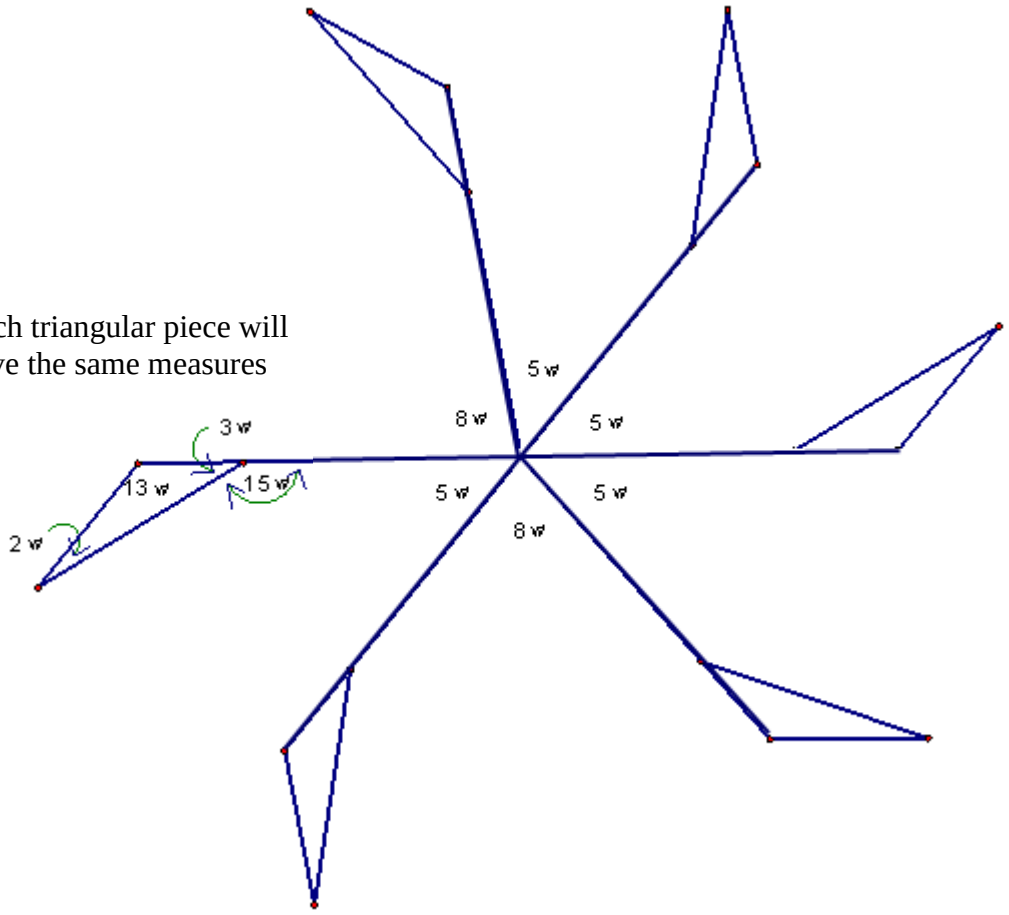
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look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

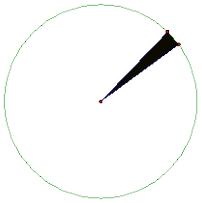
Make sure students are recording their angle measures in a way that allows them to communicate which angle has the indicated measure.

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.

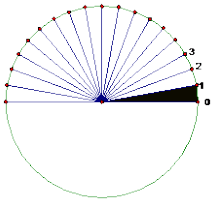


You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?

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.



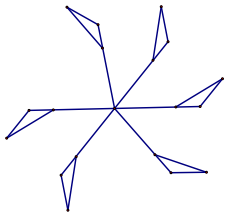
Discuss the following questions with your partner. Be prepared to share your thoughts with the class.

- 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

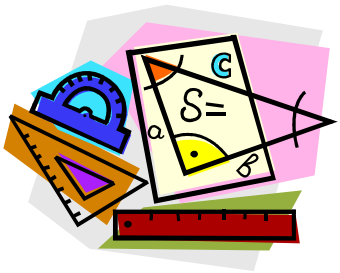
- Ask students to create their own design using an angle ruler. Have students share design and measure the angles contained within the design.

Intervention

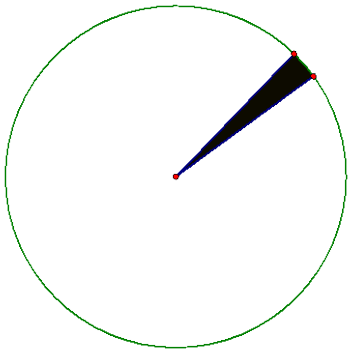
- Discuss possible angles to measure within the Rafe's design, being sure students are able to identify the vertex.

Name _____ Date _____

Build an Angle Ruler



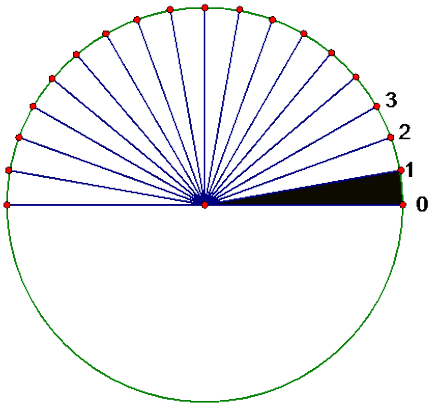
You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?



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.



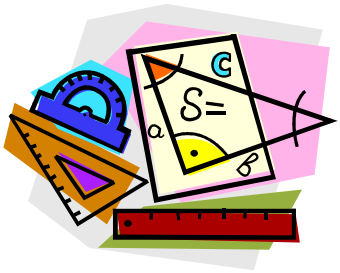
Discuss the following questions with your partner. On the back of this paper, record your answers to the questions. Be prepared to share your thoughts with the class.

- 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 _____

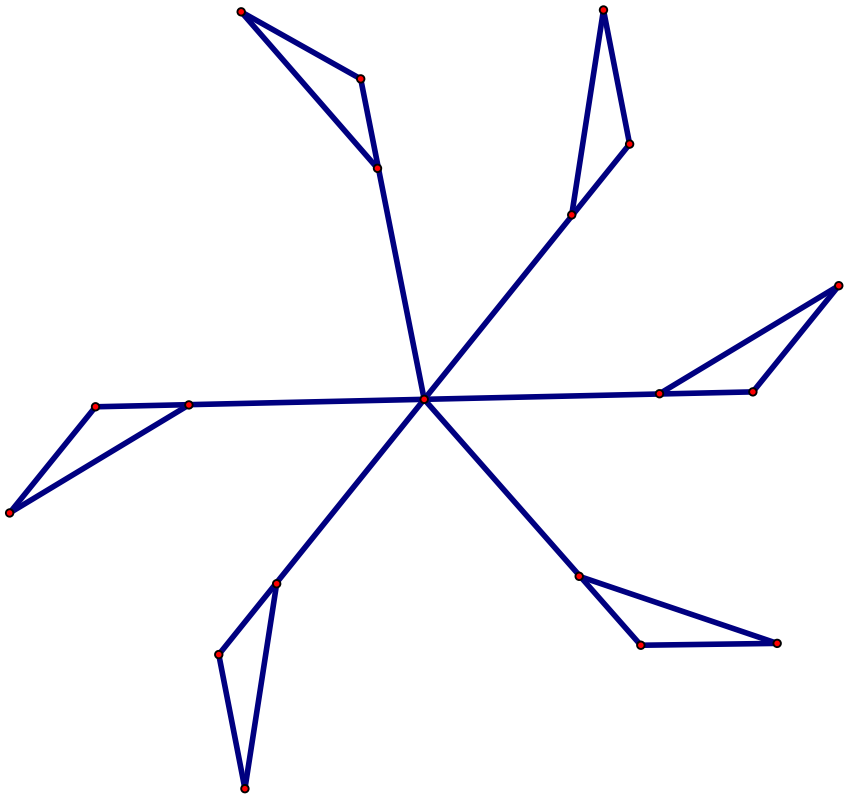
Build an Angle Ruler

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: