LessonTitle: **All About Angles** **Geo 2.2a,b,c**

Utah State Core Standard and Indicators Geometry Standards 3.1, 4.1 Process Standards 1-4

Summary

This lesson is introduced using the book, "Sir Cumference and the Great Knight of Angleland." It involves students in using hinged mirrors to understand the connection between angles and circles, and in measuring angles in various pattern blocks. Students explore the basic concept of an angle using a hinged mirror and pattern blocks. Then they classify and measure angles. They build different triangles with specified kinds of angles.

Enduring Understanding	Essential Questions
We orient ourselves by the circle which surrounds us at any given time. Anything we create on a plane surface or in space also must have a circular orientation. Therefore angles which measure circular distance are extremely important to any kind of directional orientation or construction in our world.	What are angles and how do you measure them? What is the pattern for the sums of angles in different polygons? How can we use this pattern to help us?

Skill Focus	Vocabulary Focus
• Measuring angles • Identifying different kinds of angles • Creating polygons with different sides and angles • Using hinged mirrors to understand angle reflection • Polygon angles	

Assessment

Materials Pattern Blocks, hinged mirrors, strips of centimeter graph paper , scissors, string.

Launch

Explore

Summarize

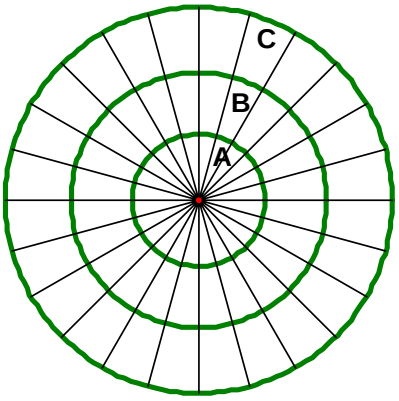
Apply

Directions:

- Practice measuring angles using a protractor.
- Help students understand angle measurement using circular visualization in the hinged mirror activity below.
- The hinged mirror activity is much like "Smoke and Mirrors" found in NCTM's Navigating Through Algebra pages 69-71 and student worksheets pages 125-126. Use one or the other or both to help students understand the angle measures in polygons.

Geo 2.2a Angles with Hinged Mirrors

1) What is an angle? Use the circle drawing to help you understand and explain.



2) Why can angles in circle A be the same size as angles in circle B and C?

3) Nest a square pattern block between hinged mirrors. Draw what you see in the mirrors.

Why do you see what you see?

4) If there are 360 degrees in a circle, use the hinged mirrors to figure out the size of the angles in the following pattern blocks.

Green Triangle angles = _____
Yellow Hexagon angles = _____
Blue Rhombus Small angle = _____
Large angle = _____
White Rhombus Small angle = _____
Large angle = _____
Red Trapezoid Small angle = _____
Large angle = _____

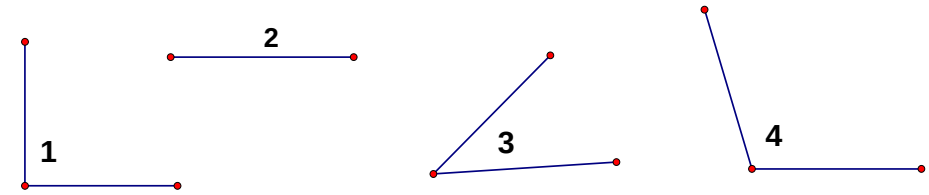
5) Draw a dot and a line (as below) on a small sheet of paper. Use the mirrors. Place them so the dot is inside and near the vertex of the mirrors. Make certain the mirrors cross the line. Move the hinged mirrors from a small opening (angle) to a large opening (angle)

What do you see? How does the angle of the hinged mirror affect what you see in the mirror? Record your ideas about what you see.

Geo 2.2b What's the Angle? What's the Shape?

(taken from Connect to NCTM standards)

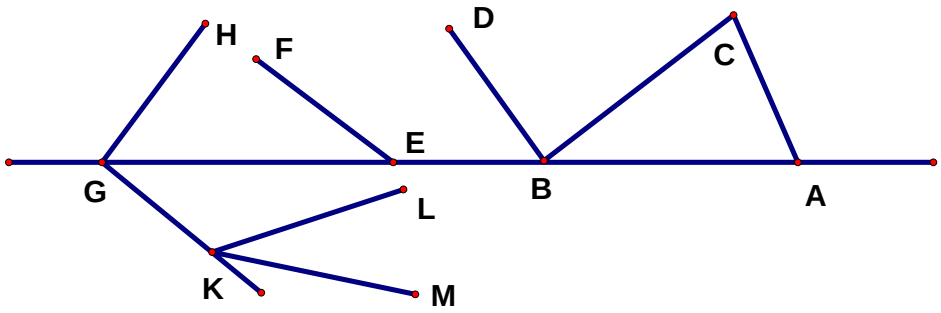
1) Classify each angle as acute, right, obtuse, or straight. Then measure each angle.



_____ _____ _____ _____

_____ _____ _____ _____

2) Measure each angle in the figure below. Classify each angle as acute, right, obtuse or straight.



ABC_____ _____ CBD_____ _____

DBE_____ _____ BEF_____ _____

FEG_____ _____ HGE _____ _____

HGK_____ _____ GKL _____ _____

GKM _____ _____ ACB_____ _____

4) Work with a partner to create the following shapes. Use strips of centimeter graph paper, cut them to given lengths and move them to create the shape. If it isn't possible, then write not possible and explain why. If it is possible, then draw the figure.

a) A triangle with sides of 12 cm and 7 cm. The third side can be a length so that the angle opposite the 7 cm side measures 30 degrees.

b) A triangle that fits the same description as above but looks different.

c) A triangle with sides of 12 cm and 4 cm. The third side can be a length so that the angle opposite the 4 cm side measure 30 degrees.

d) A triangle with three angles that each measure 60 degrees and all sides equivalent.

e) A quadrilateral with angles that measure 70, 80, 90 and 100 degrees.

f) A quadrilateral with sides that measure 4,8,9 and 15 meters.

g) A triangle with angles that measure 20, 70 and 90 degrees.

h) A triangle with sides that measure 5, 12, and 13 cm.

i) A triangle with sides that measure 4, 6, and 11 cm.

j) A quadrilateral with sides that measure 3, 4, 5, and 15 cm.

k) A closed shape with no angles.

l) A quadrilateral with three angles each measuring 120 degrees.

m) A triangle with two angles measuring measuring more than 85 degrees.

n) Paul lives 2 miles from Rita, and Rita lives 3 miles from the shopping mall.

What are the shortest and longest Distances Paul could live from the mall?

o) Sharon has some boards that measure 3, 4, and 8 feet. Without cutting any of the boards, can Sharon wall off an area in her yard to use as an herb garden? Draw and explain.

Geo 2.2c Polygon Angles

1) How can you prove that a triangle's angles add to 180 degrees and that a quadrilateral's angles add to 360 degrees?

Be prepared to share your groups' method.

2) Is there a pattern for the sums of angles in polygons? Is the pattern related to the number of sides?

s # of sides in a polygon	d sum of the polygon angles
3 (triangle)	180 degrees
4 (quadrilateral)	_____
5 (pentagon)	_____
6 (hexagon)	_____
7	_____

How can you prove your pattern?

What could you do with the number of sides to figure out the total degrees of the angles for any polygon? Total degrees (d) = _____