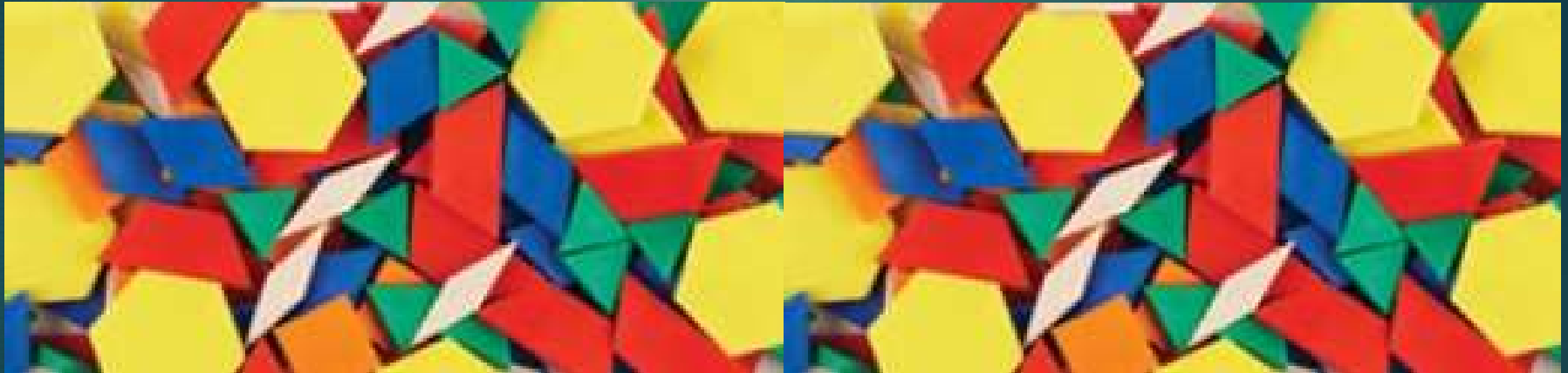


Pattern Blocks

The Forgotten Tool in Middle School



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In This Session You will Learn...

- ▶ How our understanding of definitions of shapes may have shifted
- ▶ The geometric progression with respect to angle relationships and dilations
- ▶ How pattern blocks can be used as a tool to investigate angle relationships and dilations
- ▶ Which Standards of Mathematical Practices are supported through these types of investigations



Defining Shapes

Shapes

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- ▶ What do you notice?
- ▶ What are the names for each shape?
- ▶ Why do some shapes have more than one name?

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Defining Shapes

Always, Sometimes, Never

- ▶ A triangle is a parallelogram.
- ▶ A square is a parallelogram.
- ▶ A square is a rectangle.
- ▶ A rectangle is a square.
- ▶ A trapezoid is a parallelogram.
- ▶ A parallelogram is a trapezoid.



What is a trapezoid?

Moffett and Hagman are studying parallelograms and trapezoids. They agree that a parallelogram is a quadrilateral with two pairs of parallel sides.

What is a trapezoid?

Hagman says,

A trapezoid has one pair of parallel sides and a parallelogram has two pairs of parallel sides. So a parallelogram is also a trapezoid.

Moffett says,

No- a trapezoid can have only one pair of parallel sides.

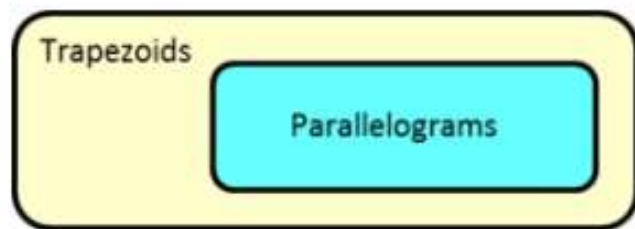
Hagman says,

That's not true. A trapezoid has at least one pair of parallel sides, but it can also have another.

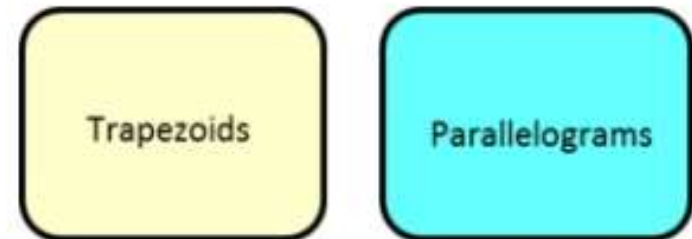
What is the difference between their definitions for a trapezoid?

Which picture represents the relationship between trapezoids and parallelograms for each definition?

a.



b.



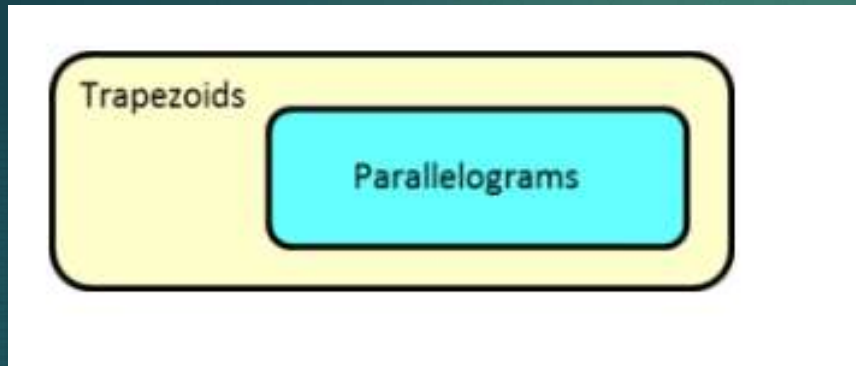
c.



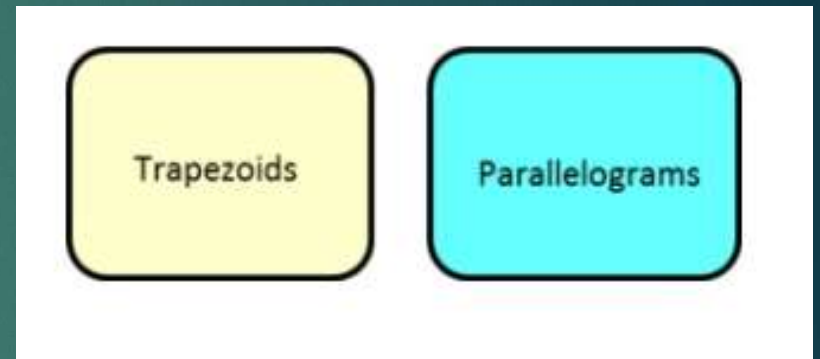
So Who is Correct?



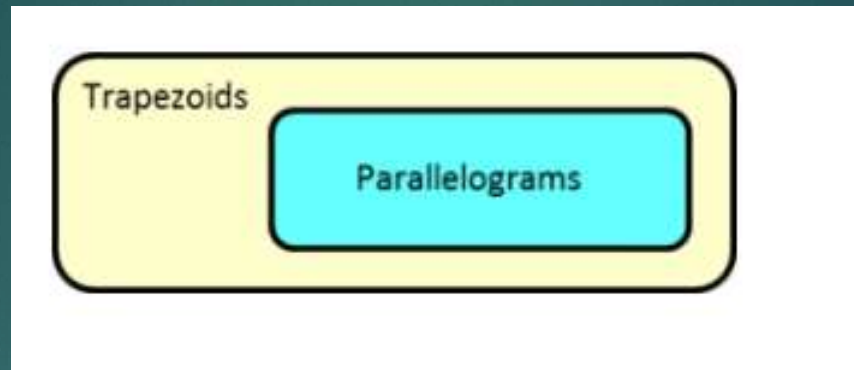
Hagman



Moffett



Inclusivity



The inclusive definition sets up a relationship between parallelograms and trapezoids that is exactly analogous to the relationship between squares and rectangles; the definition for rectangles includes squares in the same way that the inclusive definition of trapezoids includes parallelograms.

Angle Relationships



Angle Relationships Progression

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Grade 4

Understand angle concepts and how angles are formed

Recognize angle measure as additive

Measure and draw angles using a protractor

Grade 5

Describe and categorize two-dimensional figures by their attributes (e.g. all rectangles have four right angles and squares are rectangles, so all squares have four right angles)

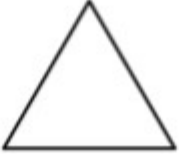
Grade 7

Use facts about supplementary, complementary, vertical and adjacent angles to write and solve equations for an unknown angle in a figure

Angle Measure Exploration

- ▶ A straight angle is 180° .
- ▶ An angle that turns through a complete rotation is 360° .
- ▶ How could we use pattern blocks to find the measure of the interior angles of an equilateral triangle?

equilateral triangle

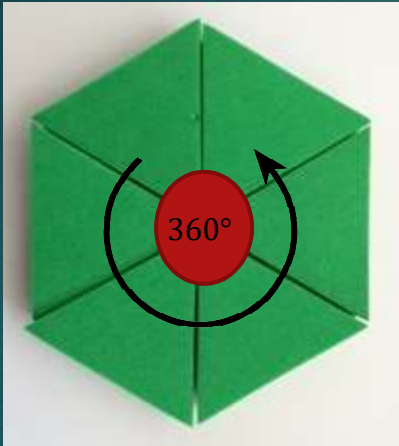
1. Name: _____

Sum: _____

This is a review from Grade 4, MD.C5.a.

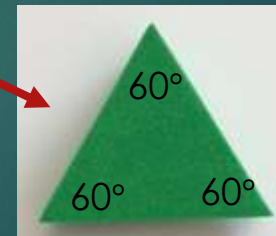
Angle Measure Exploration

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Divide the center (360°) by 6 for the interior angles of the triangles (60°). Since each triangle is equilateral, each interior angle must be the same, so all of the interior angles are 60° .



Your Turn!

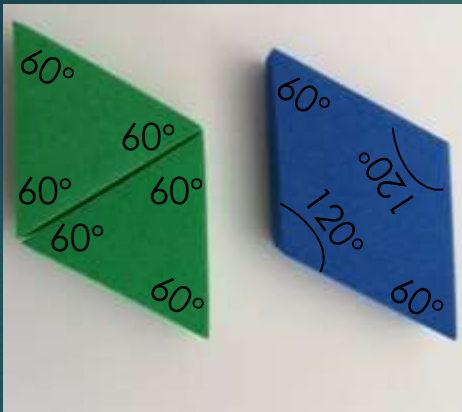
Find the interior angle measures for the other polygons. Be prepared to share your thinking.



Angle Measure Exploration

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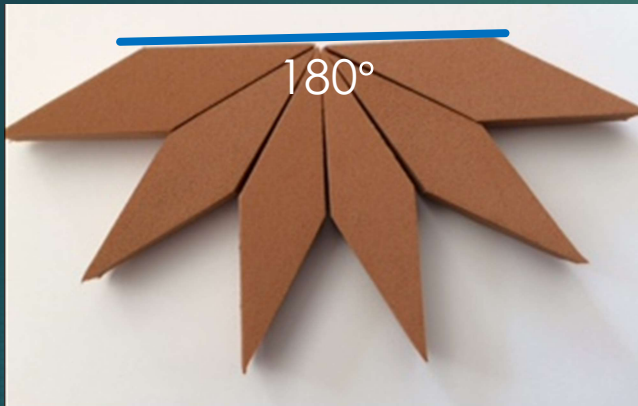
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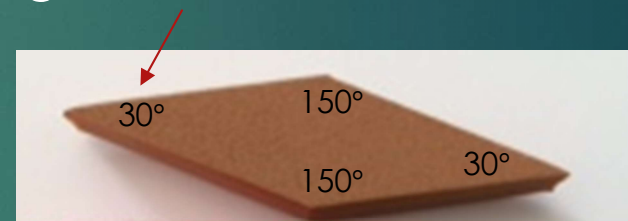
Two equilateral triangles can create the rhombus. We know each interior angle in the triangle is 60° . Add the two interior angles to create the obtuse angles on the rhombus (120°).

Angle Measure Exploration

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6 of the parallelogram's acute angles create a straight angle (180°). Divide 180° by 6. Each acute angle is 30° .



The obtuse angle of the parallelogram can be created by adding the trapezoid's obtuse angle with the acute angle on the parallelogram. $120^\circ + 30^\circ = 150^\circ$.

Angle Measure Exploration

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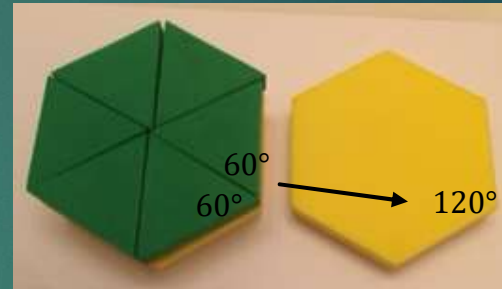
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Below are a few strategies students have used for obtaining angle measures for pattern blocks.

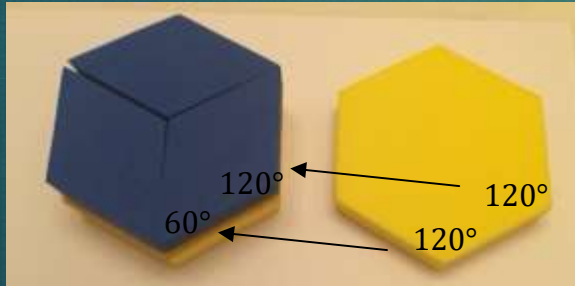


180°

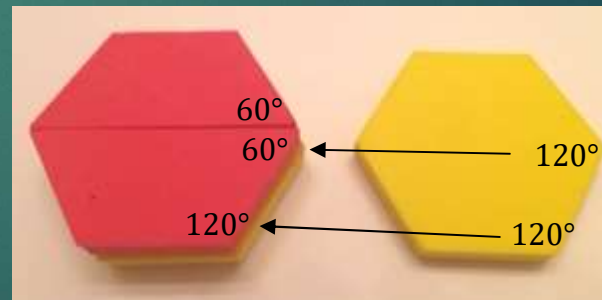
The obtuse and acute angles of a parallelogram are supplementary.



The sum of two interior angles of an equilateral triangle create an interior angle of a hexagon.



The acute angle on a rhombus is half of the interior angle of a hexagon.



The acute angle on a trapezoid is half of the interior angle of a hexagon.

Make a Protractor!

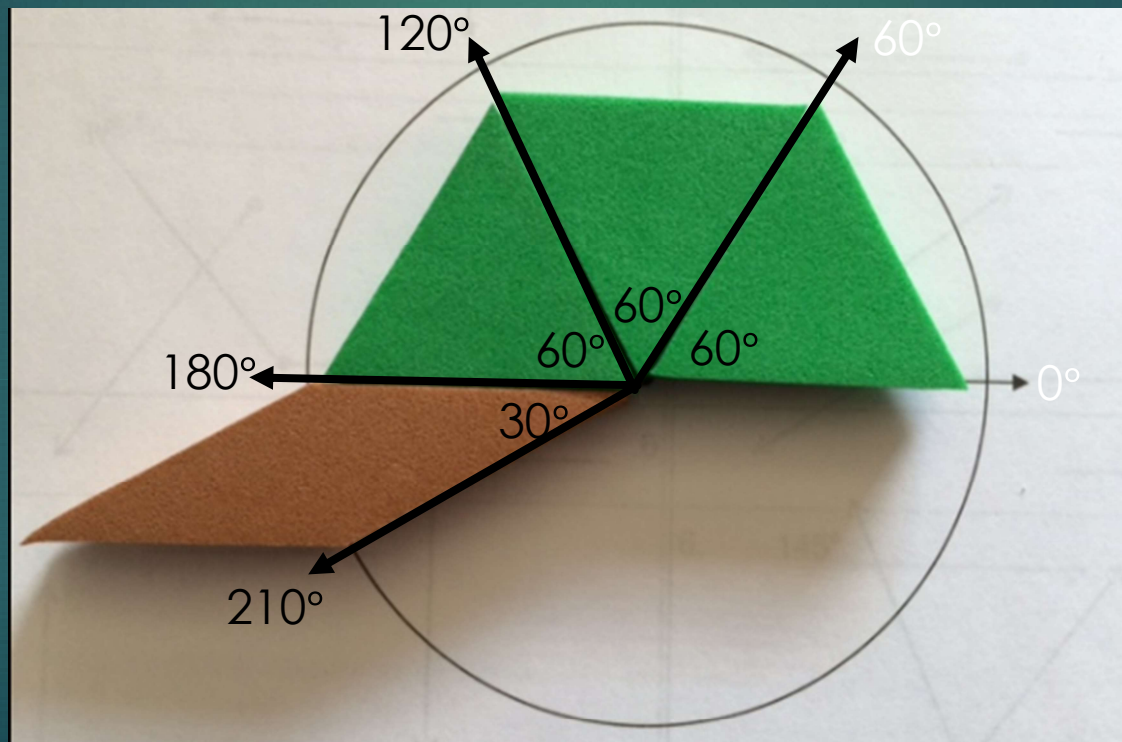
Use what you NOW know about the measures of the angles of the shapes and CHOOSE tools you find helpful (other than a protractor –wah wah) to create a circular protractor with at least 16 different angle measures on it.

- ▶ Locate 0° with the ray
- ▶ Label angles in a counter-clockwise direction
- ▶ Note the angle that makes one full rotation around the circle is 360° .

Make a Protractor

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Students use their pattern blocks and additive angle concepts to create a protractor with at least 16 angle measures.

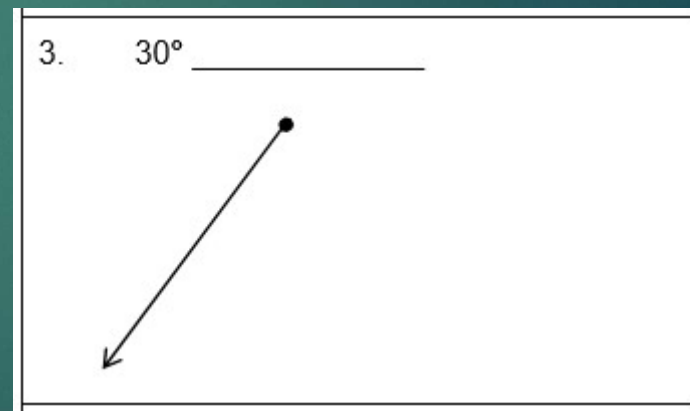
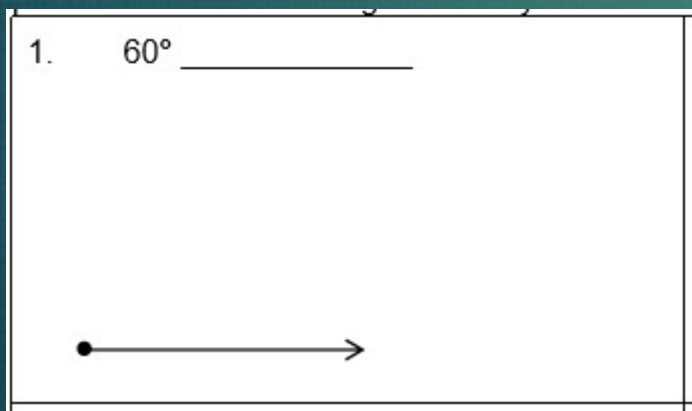


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Grade 4 MD.C.5. a, b.

Drawing Angles with Your Protractor

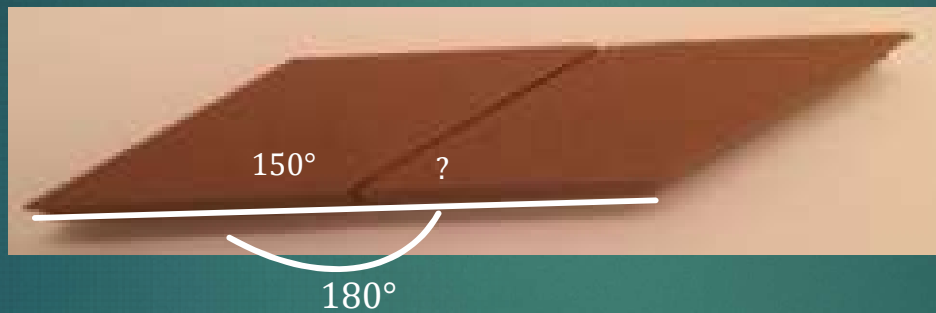
- ▶ One ray and the vertex of each angle is given.
- ▶ Using your protractor or pattern blocks, create the angle for the given degrees.



Integrating Equations and Expressions

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Who Am I?

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When I am added to an **equilateral triangle**, we are considered supplementary angles. Who am I?

- ▶ What equation could you use to represent this relationship?
- ▶ What is the missing angle?

Who Am I?

When added to the acute interior angle of a rhombus, we are considered complementary angles. Who am I?

- ▶ What equation could you use to represent this relationship?
- ▶ What is the missing angle?

Who Am I?

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When two of us share a vertex with a **hexagon**, we are 360° . Who are we?

- ▶ What equation could you use to represent this relationship?
- ▶ What is the missing angle?

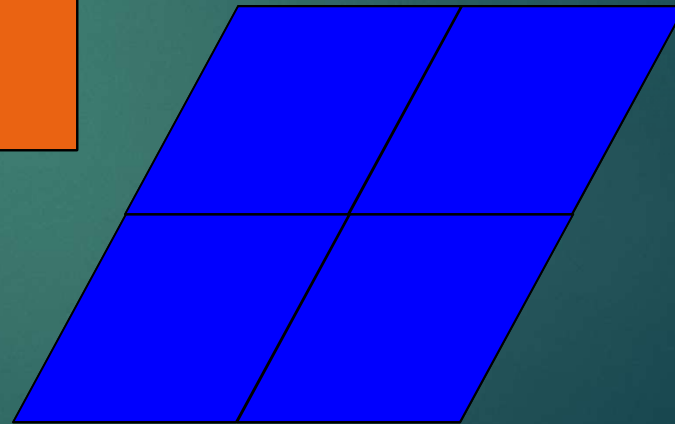
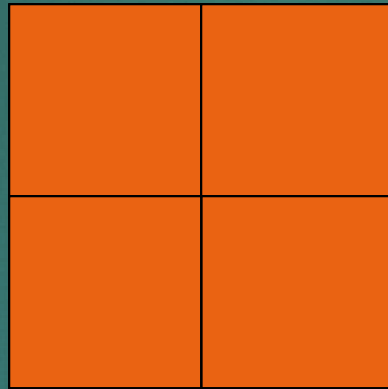
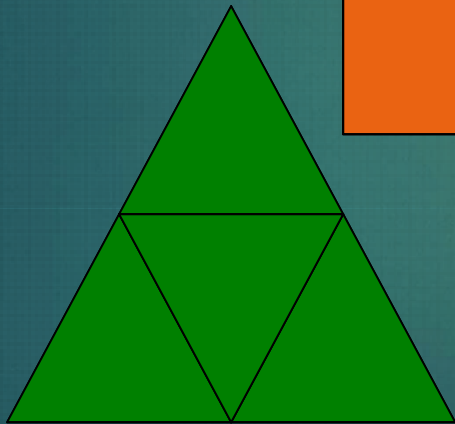
Dilations



Pattern Block Dilations

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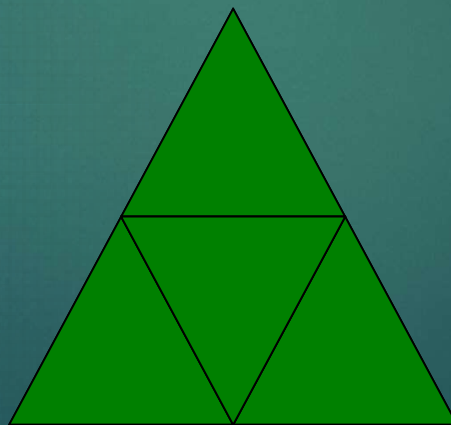
- Choose one of the following sets to create:



Pattern Block Dilations

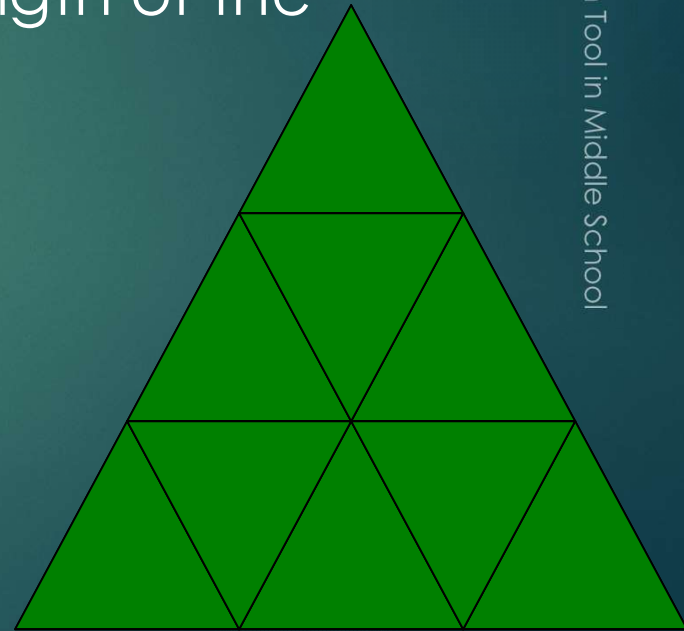
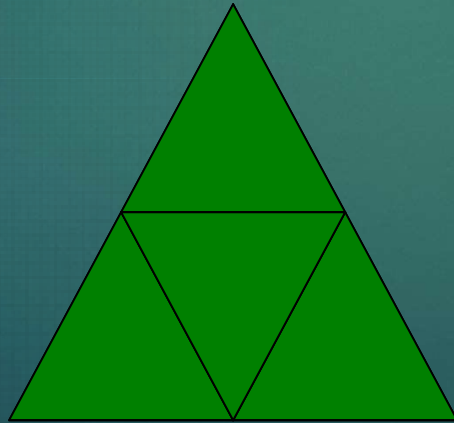
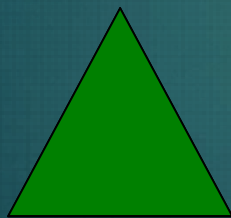
What is the relationship between the following distances???

- ▶ From your eye to the sheet protector
- ▶ From the sheet protector to the pattern blocks
- ▶ From your eye to the pattern blocks



Pattern Block Dilations

- ▶ Continue to explore the relationships as you change the “side length” of your pattern block arrangement.
- ▶ Record your measurements, and make a prediction about what will happen as you continue to increase the length of the side.



Dilations Debrief

- ▶ How was the “side length” of the pattern block arrangement related to where the individual pattern block was placed?

Dilations require a fixed point (the center of dilation) and a scale factor.

- ▶ Where was our fixed point?
- ▶ What was the scale factor?

Answers to selected problems posted soon!

Closure

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- ▶ Why are we scaffolding elementary geometry standards into the lesson?
- ▶ How did these tasks support your middle school geometry standards?
- ▶ What MP standards did you use during this exploration?

Thank you for your time!

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