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FOR MATHEMATICS

Focus on Geometry -

Intermediate Grades

with Lisa Riggs

Welcome!

Your host

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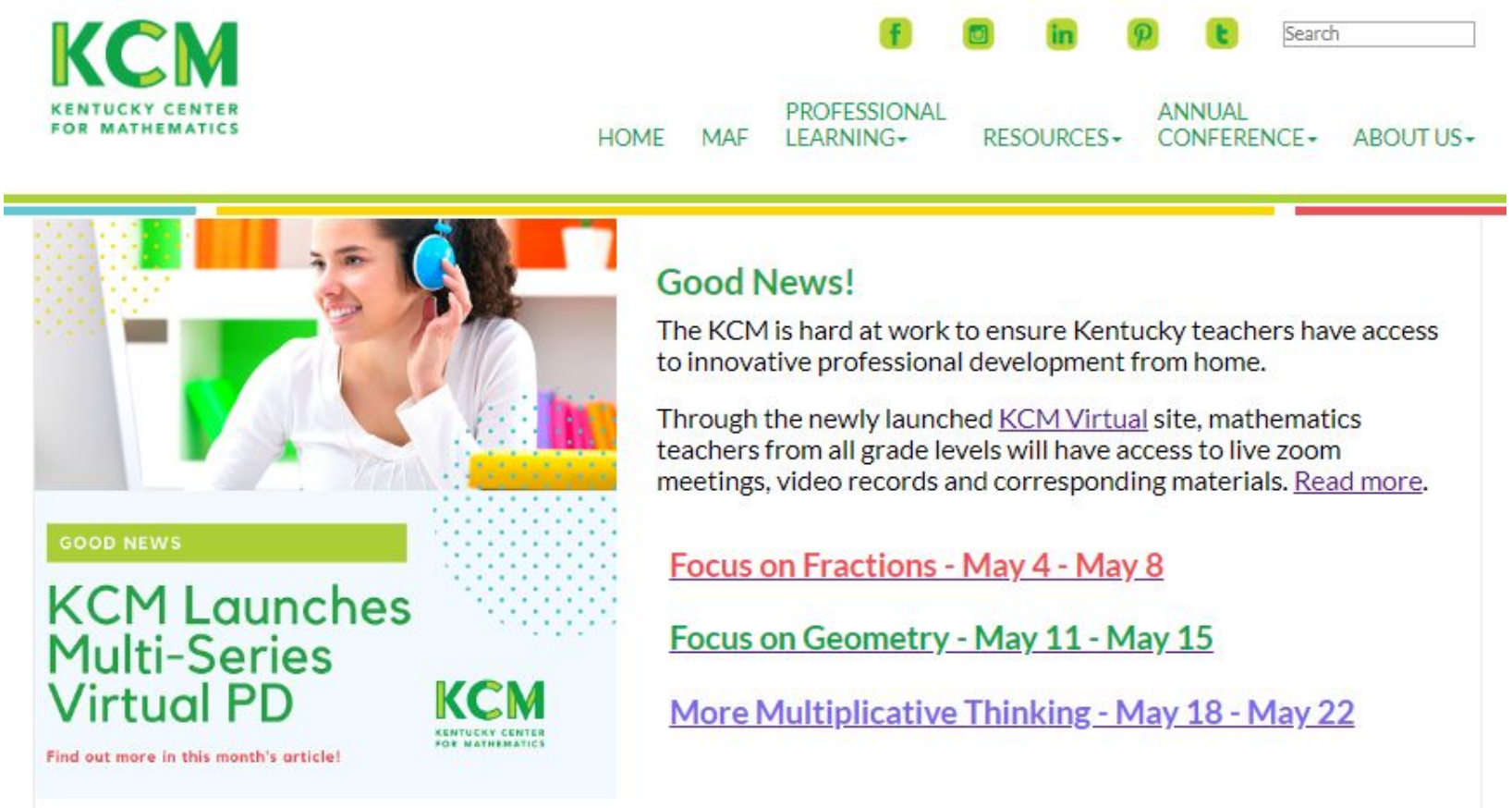
KCM Website

www.kentuckymathematics.org



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Today's Agenda

- Research-
  The van Hiele Levels of Geometric Thought
- Standards -
  Measurement and Data
  Geometry
- Model lesson - area and perimeter
- KNPI activites
- Desmos
- Geogebra

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Van Hiele Model
Levels of Geometric Thinking

Level 0: Visualization

Level 1: Analysis

Level 2: Informal Deduction

Level 3: Deduction

Level 4: Rigor

- Levels are sequential.
- Not age dependent.
- Geometric experience is key
- Instruction must match student's level of thought.

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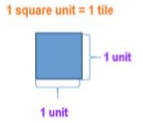
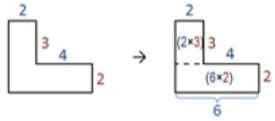
Standards

3rd Grade: Measurement and Data

Measurement and Data	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: Geometric measurement: understanding concepts of area and relate area to multiplication and to addition.	
Standards	**Clarifications**
KY.3.MD.5 Recognize area as an attribute of plane figures and understand concepts of area measurement. **MP.5**	A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area and can be used to measure area.  A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.  Coherence KY.3.MD.5→KY.5.MD.3
KY.3.MD.6 Measure areas by counting unit squares (square cm, square m, square in, square ft. and improvised units). **MP.5, MP.6**	Students use grid paper of varying square units to count the number of unit squares in a figure. Coherence KY.2.G.2→KY.3.MD.6→KY.5.MD.4
KY.3.MD.7 Relate area to the operations of multiplication and addition. a. Find the area of a rectangle with whole-number side lengths by tiling it and show the area is the same as would be found by multiplying the side lengths. b. Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems and represent whole-number products as rectangular areas in mathematical reasoning. c. Use tiling to show in a concrete case the area of a rectangle with whole-number side lengths *a* and *b* + *c* is the sum of *a* × *b*	d.  Coherence KY.3.MD.7→KY.4.MD.3→ KY.5.MD.5

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Standards

3rd Grade: Measurement and Data

Measurement and Data	
Standards for Mathematical Practice	
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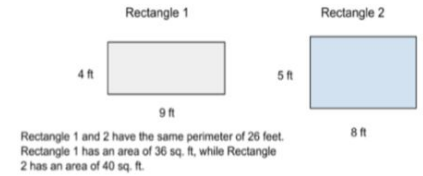
Cluster: Geometric measurement: Recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.	
Standards	**Clarifications**
KY.3.MD.8 Solve real world and mathematical problems involving perimeters of polygons. a. Find the perimeter given the side lengths of a polygon. b. Find an unknown side length, given the perimeter and some lengths. c. Draw rectangles with the same perimeter and different areas or with the same area and different perimeters. **MP.1, MP.4**	c. **Rectangles with the Same Perimeter but Different Areas**  Rectangle 1 and 2 have the same perimeter of 26 feet. Rectangle 1 has an area of 36 sq. ft, while Rectangle 2 has an area of 40 sq. ft. **Rectangles with Different Perimeters, but Same Area**  Rectangle 1 and 2 have the same area of 24 sq. feet. Rectangle 1 has a perimeter of 20 ft., while Rectangle 2 has a perimeter of 28 ft. Coherence KY.3.MD.8→KY.4.MD.3
Attending to the Standards for Mathematical Practice	
Students recognize perimeter is a measure of length and see perimeters of polygons as a collection of side lengths added together to form the perimeter (**MP.1**). Therefore, they see if a side length is missing, it is like a missing addend problem and write an equation or draw a bar diagram to solve for the missing value (**MP.4**). Students recognize they can use a given perimeter (such as 16 inches) and form different rectangles (such as 4 x 4, 3 x 5, 2 x 6, 1 x 7) and that these rectangles have different areas (**MP.1**).	

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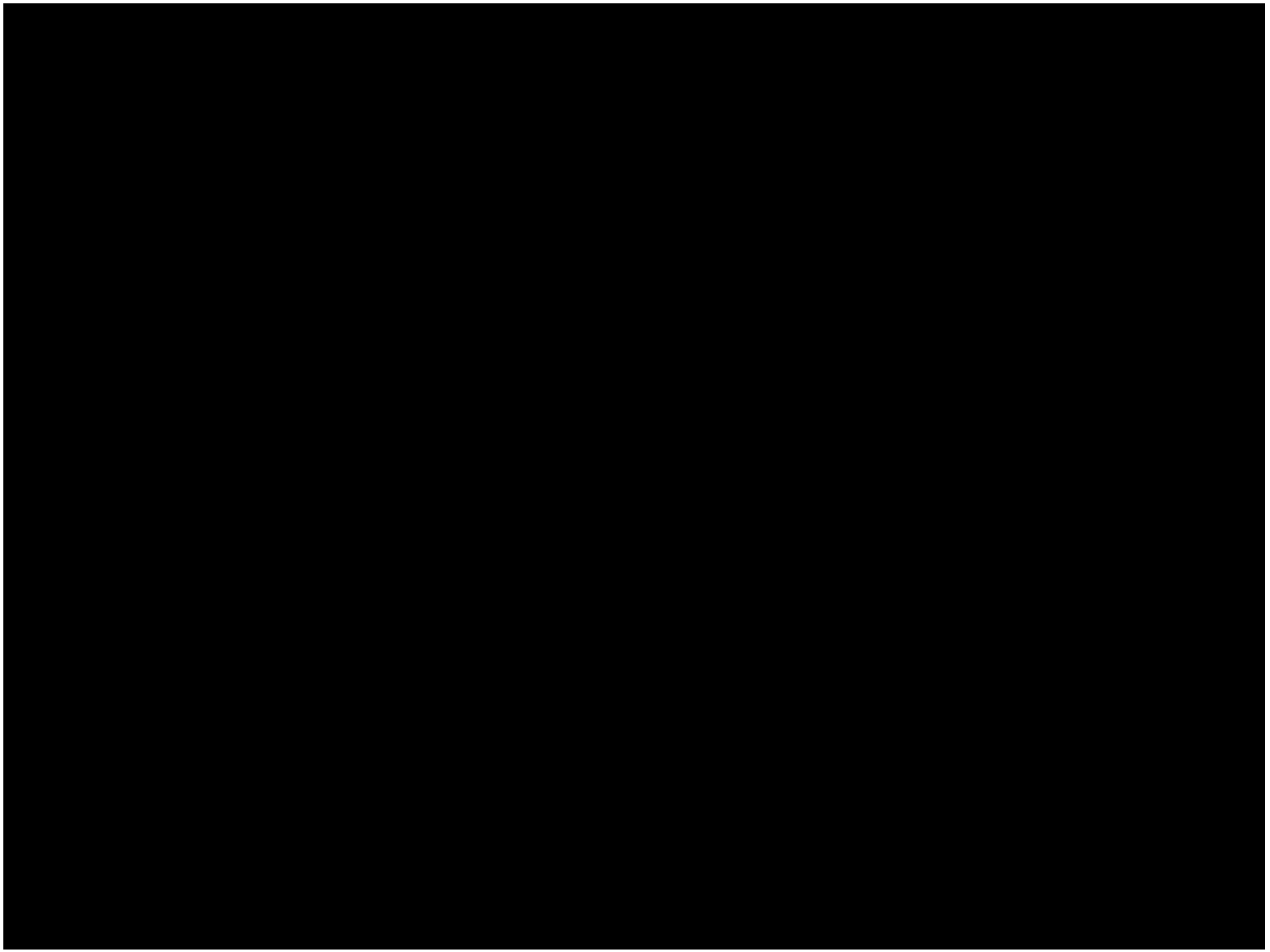
The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Area and Perimeter - Table for 22



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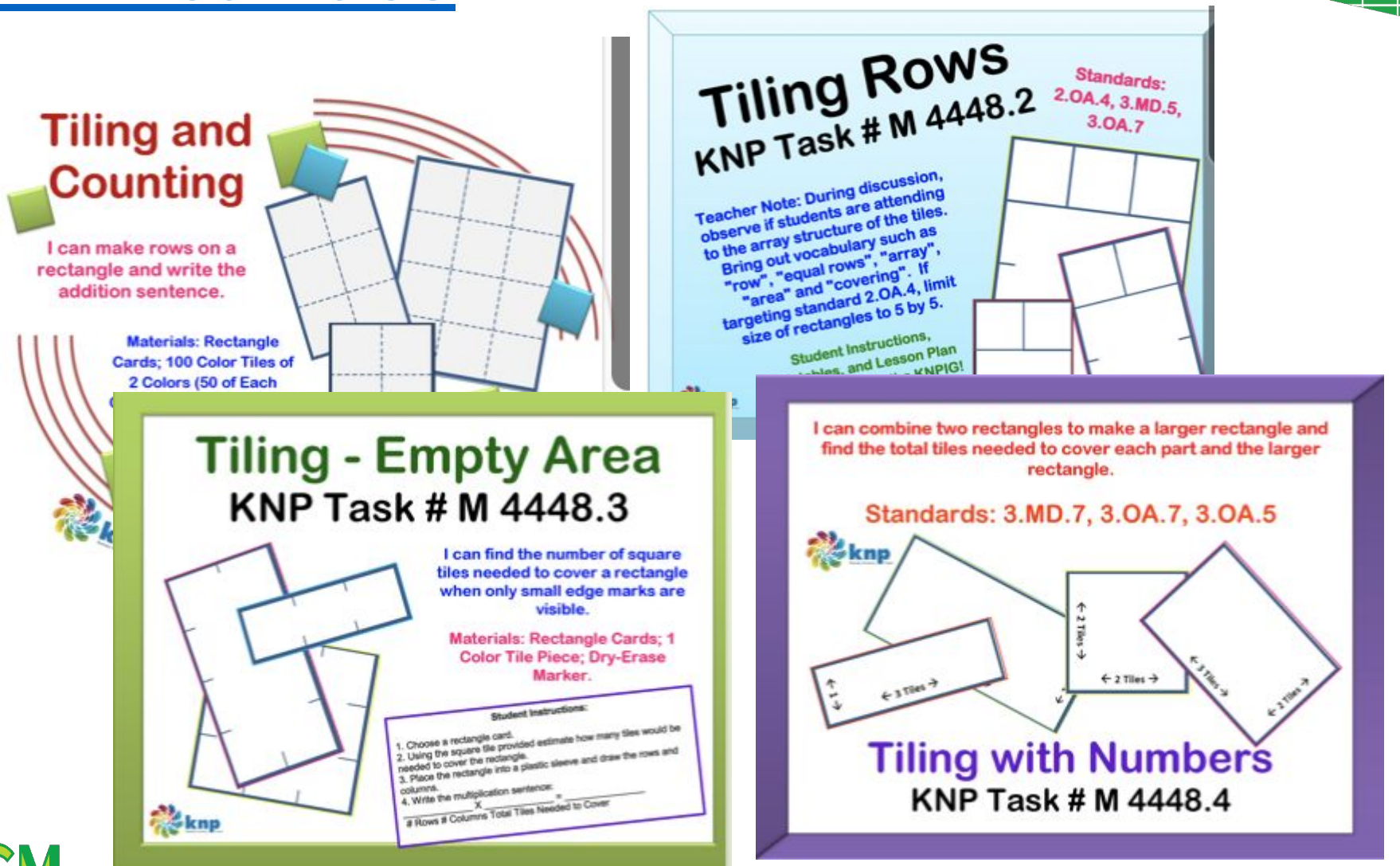
KNPI Activities



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Standards

3rd Grade Geometry

Geometry	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: Reason with shapes and their attributes.	
Standards	**Clarifications**
KY.3.G.1 Classify polygons by attributes. a. Recognize and classify polygons based on the number of sides and vertices (triangles, quadrilaterals, pentagons and hexagons). b. Recognize and classify quadrilaterals (rectangles, squares, parallelograms, rhombuses, trapezoids) by side lengths and understanding shapes in different categories may share attributes and the shared attributes can define a larger category. c. Identify shapes that do not belong to a given category or subcategory. **MP.6, MP.7**	Students describe, analyze and compare properties of two–dimensional shapes. Coherence KY.2.G.1→KY.3.G.1→KY.4.G.2
KY.3.G.2 Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. **MP.2, M.5**	Partitioned parts should be halves, thirds, fourths, sixths, eighths. Students partition a shape into 6 parts with equal areas and describe the area of each part as $\frac{1}{6}$ of the area of the shape. KY.3.NF.1 Coherence KY.2.G.3→KY.3.G.2
Attending to the Standards for Mathematical Practice	
Students describe attributes they notice for a particular type of quadrilateral, focusing on side lengths and angles (**MP.6**). They explain what different types of quadrilaterals have in common and can distinguish between what are defining attributes (such as having four sides) and what are not defining (such as its size or color) (**MP.3**). Students use a variety of tools and drawings to show fractional parts (**MP.5**) and they reason if a shape is partitioned into four equal-sized parts (even if they are not the same shape), each part represents one-fourth of the whole shape (**MP.2**).	

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Standards

4th Grade Geometry

Geometry	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: Draw and identify lines and angles, and classify shapes by properties of their lines and angles.	
Standards	**Clarifications**
KY.4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse) and perpendicular and parallel lines. Identify these in two-dimensional figures. **MP.5, MP.6**	Coherence KY.3.G.1→KY.4.G.1
KY.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence of absence of angles of a specified size. Recognize right triangles as a category and identify right triangles. **MP.7**	Coherence KY.3.G.1→KY.4.G.2→KY.5.G.3
KY.4.G.3 Identify lines of symmetry. a. Recognize a line of symmetry for a two-dimensional figure. b. Identify line-symmetric figures and draw lines of symmetry. **MP. 5, MP.7**	
Attending to the Standards for Mathematical Practice	
Using technology, using straightedges and/or protractors, students draw points, lines, line segments, rays, angles and perpendicular and parallel lines (**MP.5**). Students reason about the possible relationship of two lines or line segments. For example, students might use technology, uncooked spaghetti, or lines drawn on two transparency strips, to arrange two lines in different ways to determine possible events (the two lines might intersect, might intersect and be perpendicular, or may be parallel) (**MP.7**). Students analyze, compare and sort polygons based on their sides, angles and symmetry, explaining whether an attribute is a defining characteristic of that shape (**MP.7**).	

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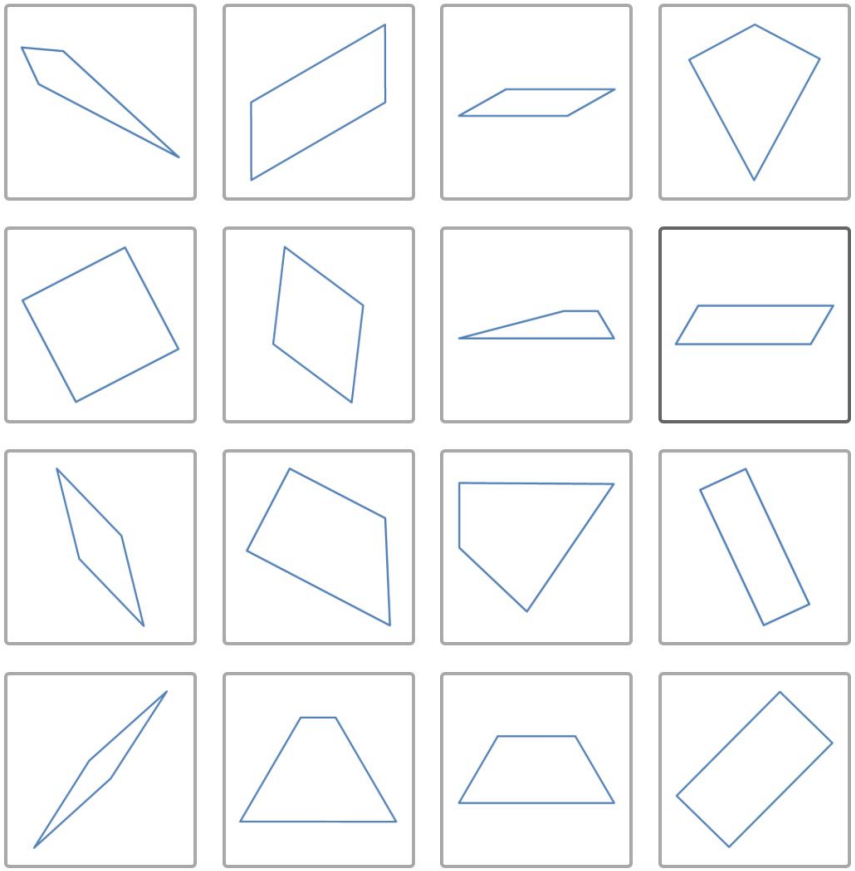
Desmos

Polygraph: Basic Quadrilaterals

Select a quadrilateral that's special to you for any reason. Next



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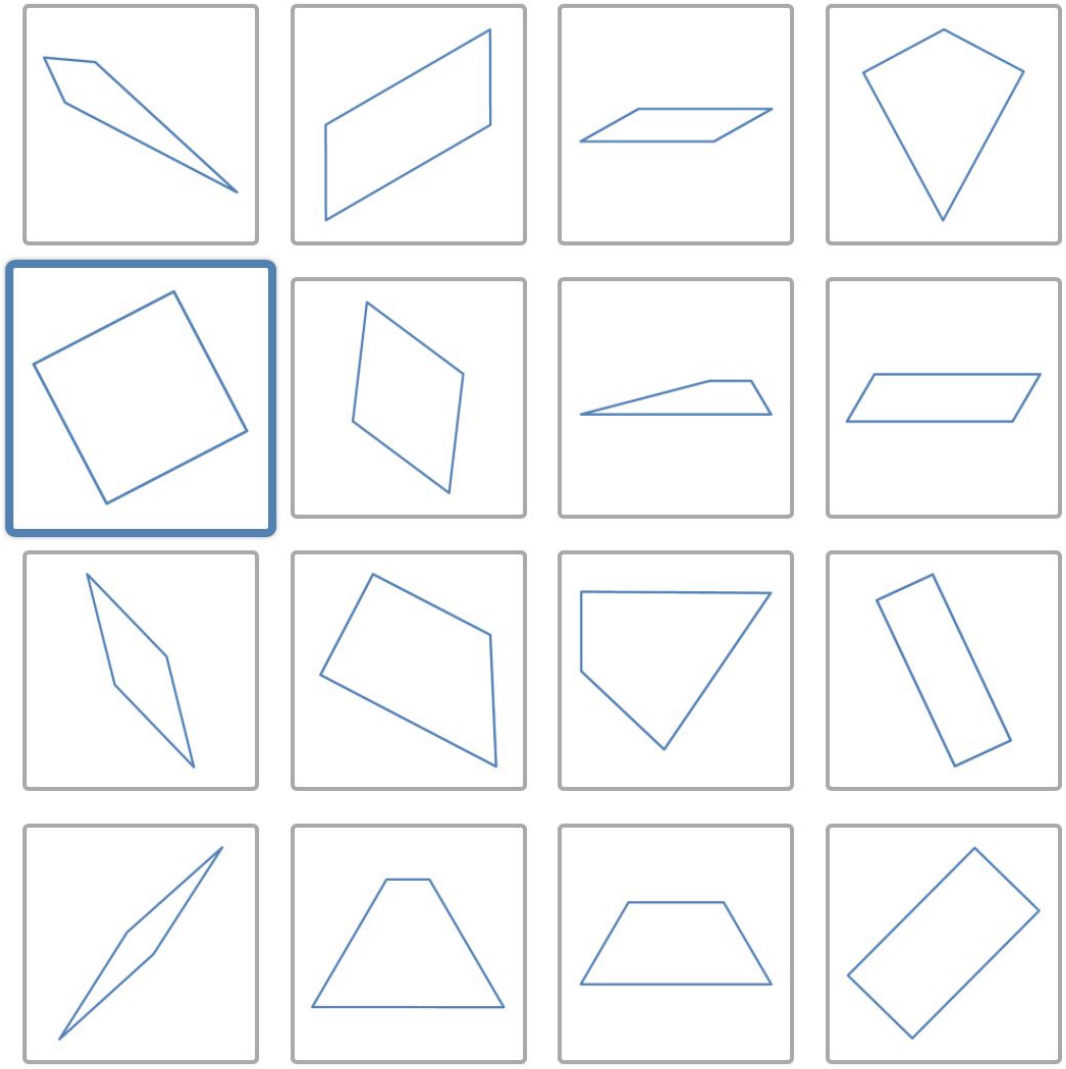
Questions Asked: 1



Your Partner: Cheryl Dicken

YOUR PARTNER ASKED

Does it have right angles?

YOU CHOSE

Yes

Watch your partner eliminate quadrilaterals based on this information.

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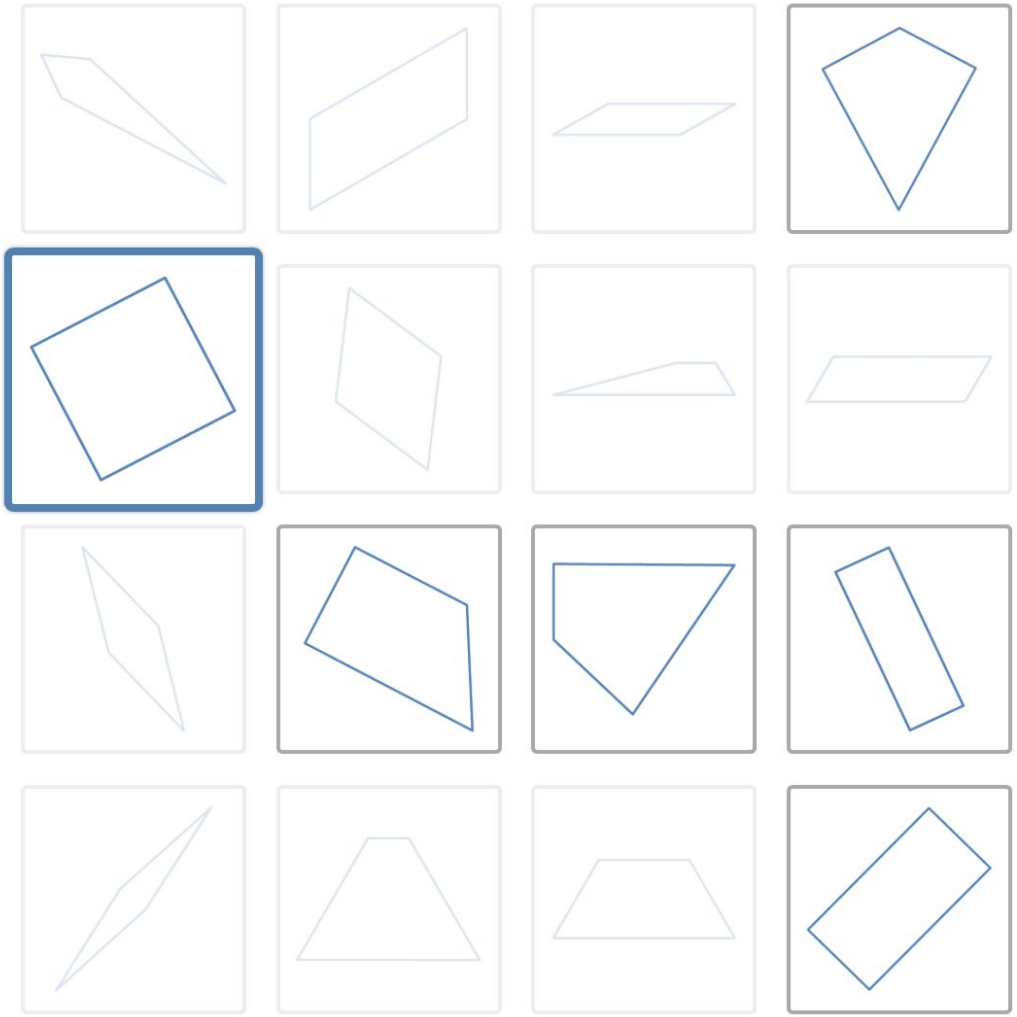
Questions Asked: 1



Your Partner: Cheryl Dicken

YOUR PARTNER ASKED

Does it have right angles?

YOU CHOSE

Yes

YOUR PARTNER ELIMINATED

× × × × × × × × × ×

Waiting for your partner's question...

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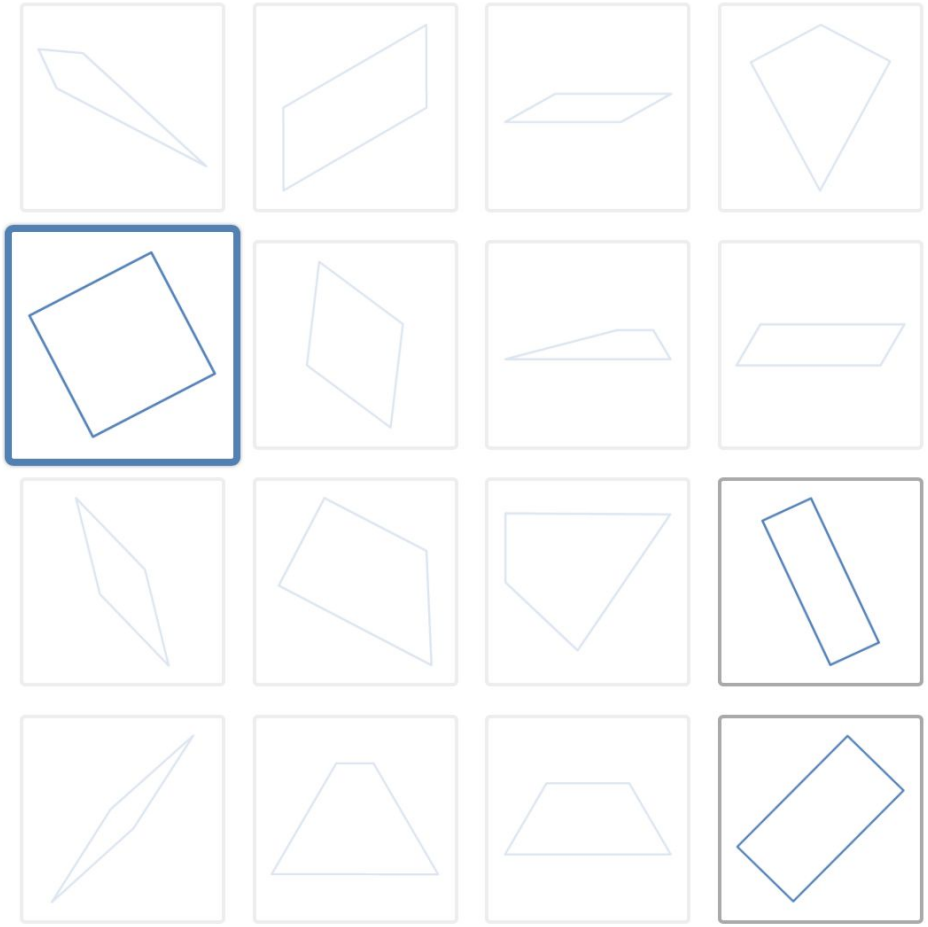
Questions Asked: 2



Your Partner: Cheryl Dicken

YOUR PARTNER ASKED
Does it have right angles?

YOU CHOSE
Yes

YOUR PARTNER ELIMINATED
× × × × × × × × × ×

YOUR PARTNER ASKED
Is it a rectangle?

YOU CHOSE
Yes

YOUR PARTNER ELIMINATED
× × ×

Waiting for your partner's question...

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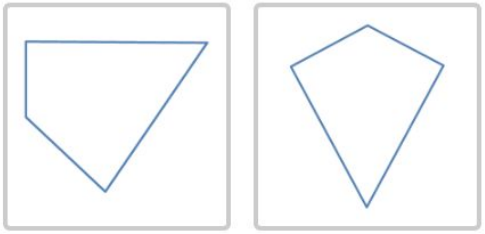
Here's a question before you start your next game...

At the end of the game, you have these two quadrilaterals remaining:



Ask a question to help you figure out the difference between these two quadrilaterals.

Submit

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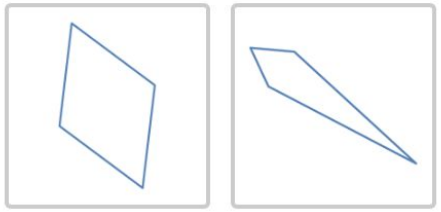
Here's a question before you start your next game...



Select all of the questions that help you figure out the difference between these two quadrilaterals.

- [ ] Ryan: Does it have an angle that is about 60°?
- [ ] Kaylee: Are all four sides the same length?
- [ ] Isaiah: Does it have any right angles?
- [ ] Abigail: Does it have two sides that are the same length as each other?
- [ ] Luis: Does it have two long sides and two short sides?

Submit

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Standards

4th Grade: Measurement and Data

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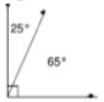
Cluster: Geometric measurement: understand concepts of angle and measure angles.	
Standards	**Clarifications**
KY.4.MD.5 Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint and understand concepts of angle measurement. **MP.7**	An angle that turns through $\frac{1}{360}$ of a circle is called a "one-degree angle," and can be used to measure angles. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees. Angles are measured in reference to a circle with the center at that common point. 
KY.4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. **MP.5, MP.6**	KY.4.MD.6 Coherence KY.4.MD.5→KY.4.MD.7
KY.4.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. **MP.1, MP.4**	For example, students use an equation with a symbol for the unknown angle measure.  25° + ☐ = 90° Coherence KY.4.MD.7→KY.7.G.5
Attending to the Standards for Mathematical Practice	
Students explore angle measures using tools (**MP.5**). For example, the white rhombus in a pattern block set or a cardboard cut-out is used as a 'unit' angle (a non-standard unit). Students use this tool to measure the size of other angles, noticing that angle measures are additive (**MP.1**). Building on concrete experiences, students explain $\frac{1}{360}$ of a circle, called a "one-degree angle," is the unit for measuring angles (**MP.7**). Students connect their concrete measuring experiences with a new tool, the protractor and use it to more precisely determine angle measures (**MP.5**, **MP.6**). When solving word problems involving angle measures, students use drawings and tools to make sense of the problem, recognizing non-overlapping angles can be added or subtracted to find missing angles (**MP.1**).	

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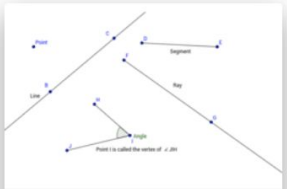
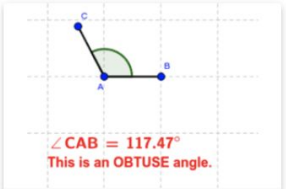
GeoGebra :Lines and Angles

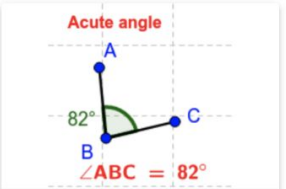
A series of applets about lines and angles for 10 to 12 year old students.



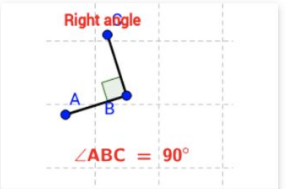
Basic Geometric



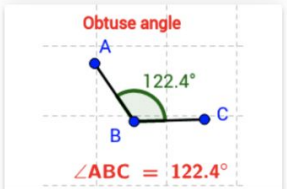
Types of angles



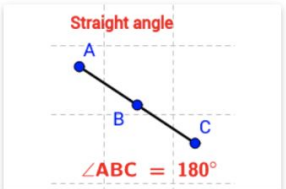
Animated acute angles



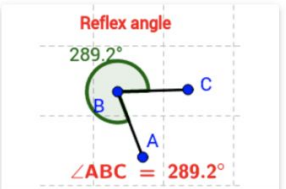
Animated view of right



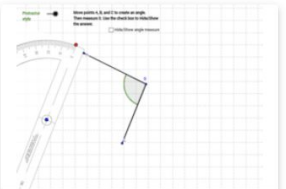
Animated view of obtuse



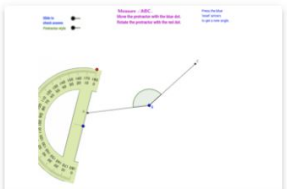
Animated view of straight

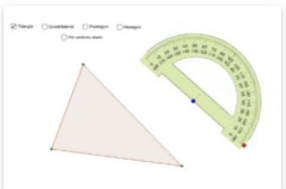


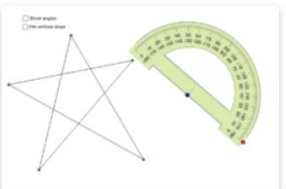
Animated view of reflex

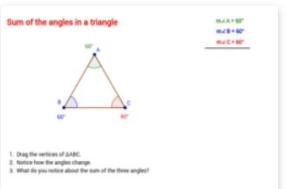


Protractor Practice (Not









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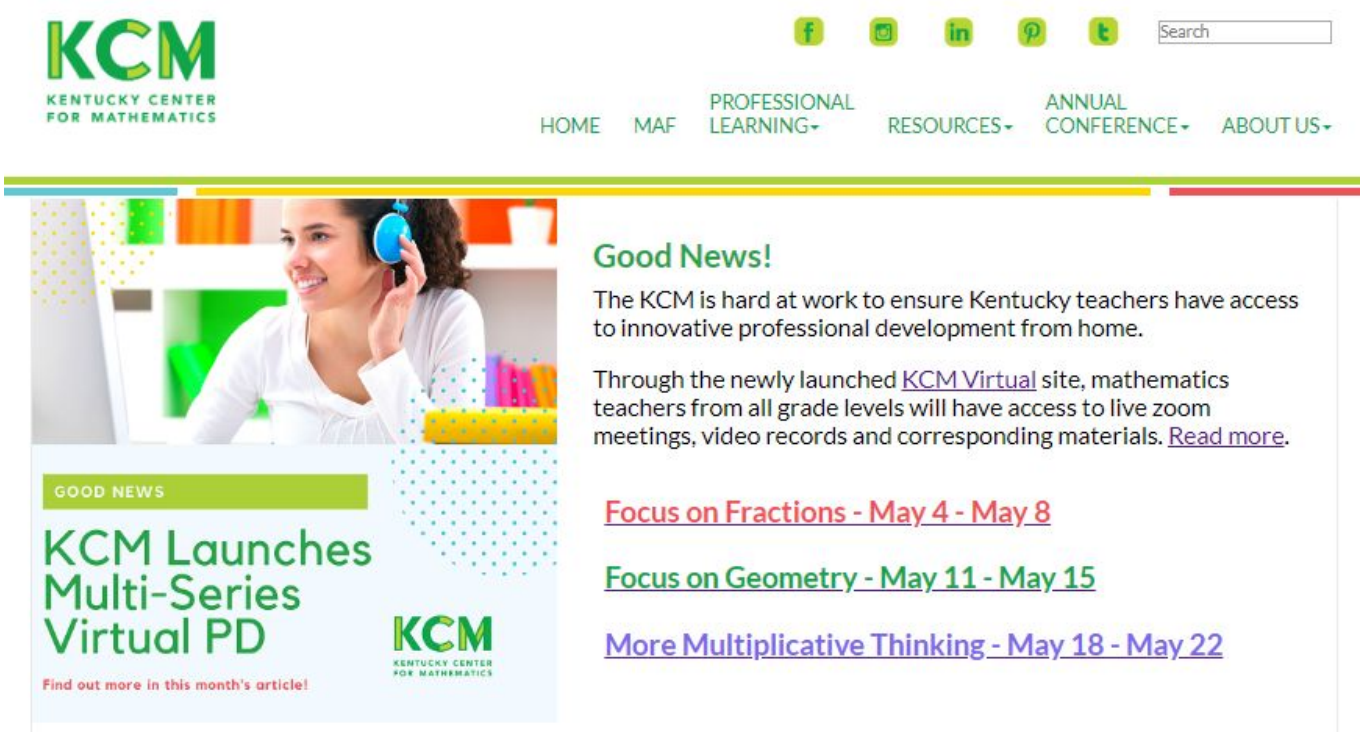

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