Parallel Lines and Transversals

Student Probe
Lines \( l \) and \( k \) are parallel lines cut by transversal, \( m \). Which angles are congruent?

Lesson Description
Students will investigate the special relationship among angles determined by a line (transversal) intersecting two or more parallel lines. This lesson uses patty paper to compare the size/measure of the angles. Students will recognize the Parallel Postulate.

Rationale
The relationships among the angles formed when parallel lines are intersected by a transversal are a direct consequence of the Parallel Postulate. As students delve more deeply into geometry, they will discover that this postulate provides the underpinnings for many additional theorems, such as the sum of the measures of the interior angles of polygons, and the relationships among quadrilaterals. The converse of the postulate provides the means for verifying that lines are parallel, an important consideration in many real world applications.

Preparation
Each student should have patty paper, ruler, and pencil.

At a Glance
What: Parallel Postulate
Common Core State Standard: CC.9-12.G.CO.9. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints.
Matched Arkansas Standard: AR.9-12.LG.G.1.5 (LG.1.G.5) Explore, with and without appropriate technology, the relationship between angles formed by two lines cut by a transversal to justify when lines are parallel.
Mathematical Practices:
Make sense of problems and persevere in solving them.
Reason abstractly and quantitatively.
Construct viable arguments and critique the reasoning of others.
Attend to precision.
Look for and express regularity in repeated reasoning.
Who: Students who do not understand the Parallel Postulate.
Grade Level: Geometry
Prerequisite Vocabulary: parallel lines, transversal, congruent, alternate interior angles, corresponding angles, alternate exterior angles.
Prerequisite Skills: tracing with patty paper
Delivery Format: Individual or pairs
Lesson Length: 15 min.
Materials, Resources, Technology: Patty paper, ruler, pencil or dynamic geometry software
Student Worksheets: none
### Lesson

<table>
<thead>
<tr>
<th>The teacher says or does...</th>
<th>Expect students to say or do...</th>
<th>If students do not, then the teacher says or does...</th>
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<tbody>
<tr>
<td>1. Use both edges of your ruler to create parallel lines. Label them ( k ) and ( l ).</td>
<td>Trace on either side of the ruler to create parallel lines. Label each line.</td>
<td>What are parallel lines? What are some examples of parallel lines? Why do we need to label the lines?</td>
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<tr>
<td>2. Now draw a transversal that intersects the parallel lines. Label the transversal ( m ), and label the angles with numbers as shown above.</td>
<td>Draw a transversal that intersects both lines. Label the transversal and label the angles with numbers.</td>
<td>A transversal is a line drawn through or across both lines. Look at the example as a guide for labeling the angles. Students should draw the transversal so it does not look perpendicular or have students draw them in different ways in groups and then explore which angle pairs are the same on everyone’s diagram</td>
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<td>3. Place a piece of patty paper over the set of angles 1, 2, 3, and 4. Copy the two intersecting lines ( m ) and ( l ) and the four angles onto the patty paper.</td>
<td>Trace lines and angles onto patty paper.</td>
<td>Teacher can hold or anchor the patty paper while student traces the lines forming the angles.</td>
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<td>4. Slide the patty paper down to the intersection of lines ( m ) and ( k ). Compare angles 1 through 4 with each of the corresponding angles 5 through 8.</td>
<td>Overlay angle 1 traced on patty paper onto angle 4 and note they have the same measure. Also angles 5 and 8.</td>
<td>Caution students to be precise with tracing and comparing of angles. Model for students.</td>
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<td>5. List all the pairs of angles with the same measure.</td>
<td>Continue tracing and comparing angles.</td>
<td>Establish a system or organization method for comparing angles and keeping track of angles with equal measures.</td>
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<tr>
<td>6. What is the relationship between corresponding angles?</td>
<td>They have the same measure.</td>
<td>Retrace or have student compare the angles again emphasizing the name for each</td>
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7. What is the relationship between alternate interior angles? They have the same measure. Retrace or have student compare the angles again emphasizing the name for each set of angles.

8. What is the relationship between alternate exterior angles? They have the same measure. Retrace or have student compare the angles again emphasizing the name for each set of angles.

9. What is a summary statement or conjecture that we can make concerning the angles formed when parallel lines are cut by a transversal? If two parallel lines are cut by a transversal, then corresponding angles, alternate interior angles, and alternate exterior angles are congruent. Compare each set of angles again.

Teacher Notes
1. A line intersecting two or more other lines in the plane is called a transversal.
2. A transversal creates different types of angle pairs. Three types are: corresponding angles; alternate interior angles, and alternate exterior angles.
3. If parallel lines are cut by a transversal, and then corresponding angles are congruent, alternate interior angles are congruent, and alternate exterior angles are congruent.
4. Vertical angles formed by intersecting lines in a plane are congruent and adjacent angles are supplementary (sum equals 180 degrees).

Variations
Interactive geometry software such as Geometer’s Sketchpad, Geogebra, or Cabri may be used in addition to patty paper.

Formative Assessment
Lines \( r \) and \( s \) are parallel. What is the measure of \( w \)? How do you know?
References
