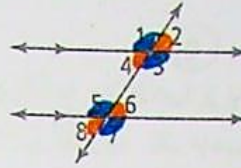


**EXPLORE & REASON**

The diagram shows two parallel lines cut by a transversal.



**2-1**  
Parallel Lines

PearsonRealize.com

A. Look for Relationships What **relationships** among the measures of the angles do you see? © MP.7

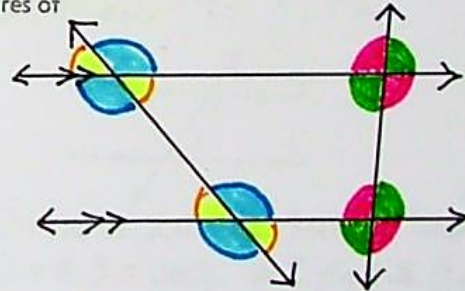
Q: What are parallel lines?

Q: The parallel lines are "cut by a transversal."  
What do you think is meant by the word "cut"?  
What do you think a transversal is?

The measure of each angle is either  $58^\circ$  (acute) or  $122^\circ$  (obtuse), so each pair of angles is either congruent or supplementary. The angles that form linear pairs are supplements and the vertical angles are congruent.

B. Suppose a different transversal intersects the parallel lines. Would you expect to find the same relationships in the measures of those angles? Explain.

Yes; the measures of the angles would change if the transversal line has a different slope, but the resulting angle pairs would still have the same relationships. The pairs of angles would be:



- Congruent
- Supplementary
- or both (if the transversal is perpendicular to the parallel lines)

**HABITS OF MIND**

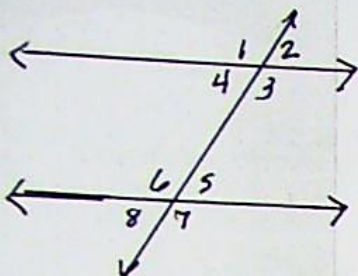
Look for Relationships What theorems have you already learned that can be used to show why some of the angles formed are congruent? © MP.7

- The Vertical Angles Theorem explains congruent angles
- The Linear Pairs Theorem explains supplementary angles



**EXAMPLE 1** **Try It!** Identify Angle Pairs

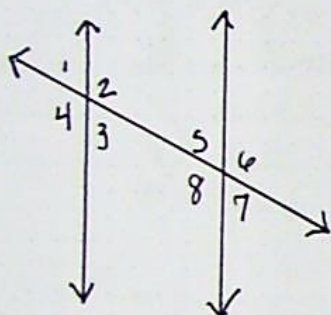
1. Which angle pairs include the named angle?  
 a.  $\angle 4$  b.  $\angle 7$



|  |                         |
|--|-------------------------|
| (a)  | (b)                     |
| Corresponding $\angle 4$ and $\angle 8$      | $\angle 7$ & $\angle 3$ |
| Alternate interior $\angle 4$ and $\angle 5$ | <del>_____</del>        |
| Same-side interior $\angle 4$ and $\angle 6$ | <del>_____</del>        |
| Same-side exterior <del>_____</del>          | $\angle 7$ & $\angle 2$ |
| Alternate exterior <del>_____</del>          | $\angle 7$ & $\angle 1$ |

**EXAMPLE 2** **Try It!** Explore Angle Relationships

2. If  $m\angle 4 = 118^\circ$ , what is the measure of each of the other angles?



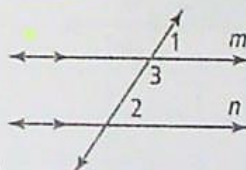
$118^\circ$  :  $\angle 4, \angle 2, \angle 8, \angle 6$   
 $62^\circ$  :  $\angle 1, \angle 3, \angle 7, \angle 5$

$$\begin{array}{r} 180 \\ - 118 \\ \hline 62 \end{array}$$

**EXAMPLE 3** **Try It!** Prove the Alternate Interior Angles Theorem

3. Prove the Corresponding Angles Theorem.

Given:  $m \parallel n$   
 Prove:  $\angle 1 \cong \angle 2$



You are given  $m \parallel n$ . Since  $\angle 1$  and  $\angle 3$  are a linear pair, their sum is 180 ( $\angle 1 + \angle 3 = 180$ ).  $\angle 2$  and  $\angle 3$  are a pair of same-side interior supplementary angles ( $m \parallel n$ ), so  $\angle 2 + \angle 3$  also equals 180. Now we have  $\angle 1 + \angle 3 = 180$  and  $\angle 2 + \angle 3 = 180$ , so  $\angle 1 = \angle 2$  by subtraction. Since  $\angle 1 = \angle 2$ ,  $\angle 1 \cong \angle 2$  because angles with the same measure are congruent.

**HABITS OF MIND**

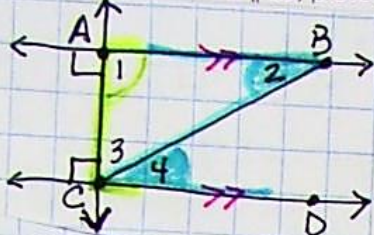
**Generalize** Suppose that a transversal intersects a pair of parallel lines, and one of the angles created measures  $x^\circ$ . What must be true of the other interior angles that are formed?  $\odot$  MP.8

The other angle measures would either be  $x$  or  $(180 - x)$



**EXAMPLE 4** Try It! Use Parallel Lines to Prove an Angle Relationship

4. Given  $\overline{AB} \parallel \overline{CD}$ , prove that  $m\angle 1 + m\angle 2 + m\angle 3 = 180$ .



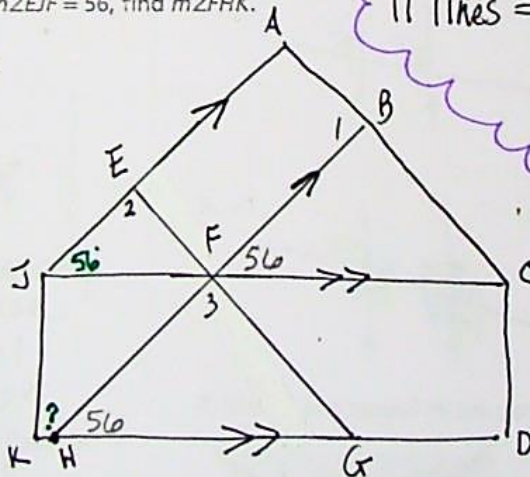
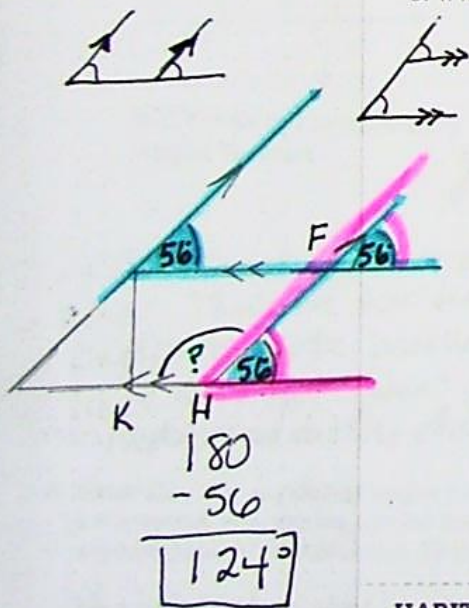
Given:  $\overline{AB} \parallel \overline{CD}$

Prove:  $m\angle 1 + m\angle 2 + m\angle 3 = 180$

| Statements                                 | Reasons  |
|--|--|
| 1) $\overline{AB} \parallel \overline{CD}$ | 1) Given   |
| 2) $\angle 1$ supp $\angle ACD$            | 2) $\parallel$ lines $\rightarrow$ same-side int $\angle$ 's supp    |
| 3) $\angle 1 + \angle ACD = 180$           | 3) If $\angle$ 's are supp $\rightarrow$ sum = 180                   |
| 4) $\angle 3 + \angle 4 = \angle ACD$      | 4) Angle Addition Postulate  |
| 5) $\angle 1 + \angle 3 + \angle 4 = 180$  | 5) Substitution Property   |
| 6) $\angle 2 \cong \angle 4$               | 6) $\parallel$ lines $\rightarrow$ alternate int $\angle$ 's $\cong$ |
| 7) $\angle 2 = \angle 4$                   | 7) If $\angle$ 's are $\cong$ , they have same measure               |
| 8) $\angle 1 + \angle 2 + \angle 3 = 180$  | 8) Substitution Property   |

**EXAMPLE 5** Try It! Find Angle Measures

5. If  $m\angle EJF = 56$ , find  $m\angle FHK$ .



$\parallel$  lines  $\Rightarrow$  corresponding angles are  $\cong$

**HABITS OF MIND**

**Make Sense and Persevere** What are some strategies you can use to find unknown angle measures?  $\odot$  MP.1

Look for:

- "Z" shape — alternate interior angles  $\cong$
- "F" shape — corresponding angles  $\cong$
- vertical angles  $\cong$
- supplementary angles (sum = 180)



### Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** What angle relationships are created when parallel lines are intersected by a transversal?

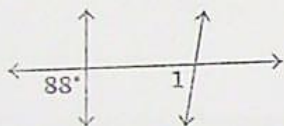
Unless the transversal is perpendicular to the parallel lines, you will always have 4 acute and 4 obtuse angles. An acute  $\angle$  + obtuse  $\angle$  will equal 180, they are supplementary, and every acute angle has the same measure / every obtuse angle has the same measure.

2. Vocabulary When a transversal intersects two parallel lines, which angle pairs are congruent?

|| lines  $\rightarrow$  corresponding  $\angle$ 's  $\cong$   
 || lines  $\rightarrow$  alternate interior  $\angle$ 's  $\cong$   
 || lines  $\rightarrow$  alternate exterior  $\angle$ 's  $\cong$

Note:  $\cong$  vertical angles do NOT depend on parallel lines!

3. Error Analysis What error did Leah make? © MP.3



$m\angle 1 = 88$  by Corresponding Angles Theorem

X

Leah cannot use this or any other Theorem for these angles because parallel lines were not "given" or indicated on the diagram.

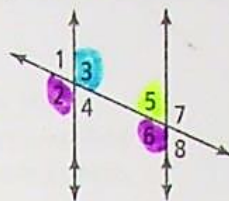
4. Generalize For any pair of angles formed by a transversal intersecting parallel lines, what are two possible relationships? © MP.8

The resulting angle pairs will always be either  
 Congruent  
 ~ or ~  
 Supplementary

### Do You KNOW HOW?

Use the diagram for Exercises 5-8.

Classify each pair of angles. Compare angle measures and give the postulate or theorem that justifies it.



5.  $\angle 2$  and  $\angle 6$

|| lines  $\rightarrow \angle 2 \cong \angle 6$ , they are a pair of corresponding angles.

6.  $\angle 3$  and  $\angle 5$

|| lines  $\rightarrow \angle 3$  supps  $\angle 5$ , they are a pair of "same-side" interior supplementary angles.

If  $m\angle 1 = 71$ , find the measure of each angle.

7.  $\angle 5$



8.  $\angle 7$



$$\begin{array}{r} 180 \\ - 71 \\ \hline 109 \end{array}$$

9. Elm St. and Spruce St. are parallel. What is  $m\angle 1$ ?



$$\begin{array}{r} 180 \\ - 112 \\ \hline 68 \end{array}$$