

Lines and Angles

Reporting Category Reasoning, Lines, and Transformations

Topic Investigating parallel lines and their relationship to special angles

Primary SOL G.2 The student will use the relationships between angles formed by two lines cut by a transversal to

- determine whether two lines are parallel;
- verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and
- solve real-world problems involving angles formed when parallel lines are cut by a transversal.

Related SOL G.1, G.3a, G.3b

Materials

- Activity Sheets 1, 2, 3 (attached)
- Dynamic geometry software package (computer-based or handheld) or protractors and/or patty paper

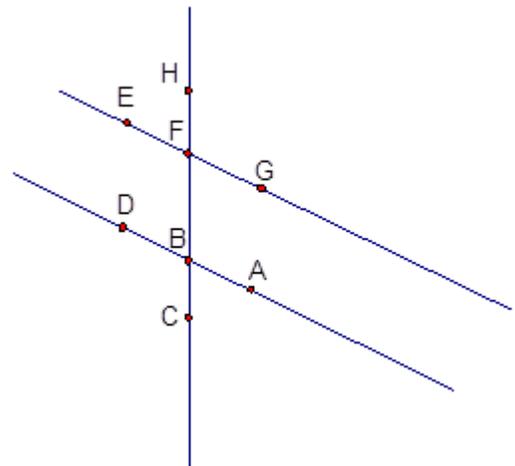
Vocabulary

parallel lines, angle, vertical angles, adjacent angles, complementary angles, supplementary angles (earlier grades)

transversal, corresponding angles, alternate interior angles, alternate exterior angles, consecutive interior (same-side interior) angles, linear pair (G.2)

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

1. Distribute copies of Activity Sheets 1 and 2, and have students use a dynamic geometry software package to complete them. If software is not available, have students use protractors or patty paper to measure the angles on the worksheet. (If neither measuring tools nor software are available, activities could be easily modified by giving students the angle measures.)
2. Remind students about the vocabulary terms they have seen before, and introduce the new vocabulary.
3. Show students that different angle pairs form different letters when traced (X—vertical angles, T—linear pair, F—corresponding angles, Z or N—alternate interior angles, C or U—consecutive interior angles, two Vs or Ls—alternate exterior angles).
4. Distribute copies of Activity Sheet 3, and have students complete it.
5. Discuss students' findings and conjectures with the



class.

6. Discuss real-world applications of parallel lines. Examples might include construction of stairs, use of a plumb line, and how a periscope works.

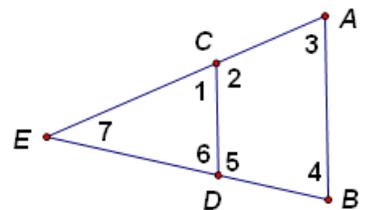
Assessment

• Questions

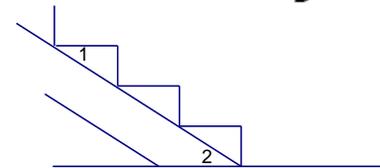
- If you are told that $\angle EFH \cong \angle DBF$, what conclusion can you make? Why?
- If you are told that $\angle EFB \cong \angle HFG$, what conclusion can you make? Why?
- If you are told that $\angle CBD + m\angle DBF = 180$, what conclusion can you make? Why?
- If you are told that $m\angle GFB + m\angle ABF = 180$, what conclusion can you make? Why?
- If you are told that $m\angle DBF = m\angle GFB = 70$, what conclusion can you make? Why?
- Which sides of the quadrilateral $ABCD$ are parallel?
How do you know this?



- Given $\angle 1 \cong \angle 3$, can you determine that any segments are parallel? If so, which ones and why? What if $\angle 6 \cong \angle 3$?



- One way to build stairs is to attach triangular blocks to an angled support, as shown on the right. If the support makes a 32° angle with the floor ($m\angle 2$), what must $m\angle 1$ be so the step will be parallel to the floor? The sides of the angled support are parallel.



• Journal/Writing Prompts

- Summarize the conclusions you have made about parallel lines and special pairs of angles.
- Name four conditions that involve angles and that are sufficient to prove that two lines are parallel.
- The white lines along the long edges of a football field are called sidelines. Yard lines are perpendicular to the sidelines and cross the field every five yards. Explain why you can conclude that the yard lines are parallel.
- When you hang wallpaper, you use a tool called a plumb line to make sure one edge of the first strip of wallpaper is vertical. If the edges of each strip of wallpaper are parallel and there are no gaps between the strips, how do you know that the rest of the strips of wallpaper will be parallel to the first?

• Other

- Have students work in pairs to evaluate strategies.
- Have groups of four students construct a short quiz covering the information presented in the class on a given day, and administer it to another group in the class.
- Have students draw a diagram showing the path of light in a periscope.

Extensions and Connections (for all students)

- Have students complete creative diagrams, using parallel lines and special angles.

Strategies for Differentiation

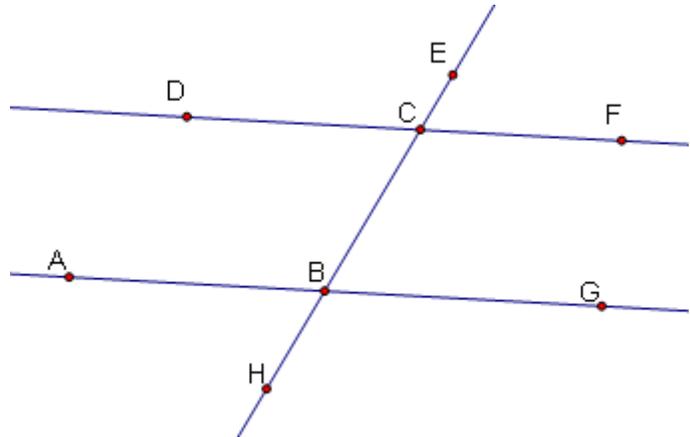
- Allow students to use a calculator (e.g., talking calculator, large number calculator).
- Vocabulary words can be illustrated and audio added into presentation software. This can then be converted to a video and played on an mp3 player.
- Provide students with index cards and have them write the definition of each word in a specific color of ink or pencil. Have them draw an illustration of the word in another color of ink or pencil. Trace the pair of angles in a color. They can use these cards to study at home or with another student.
- Using a dynamic geometry software package, have students color-code lines and angles to differentiate between them.
- Have students use different colors of yarn or string to lay out parallel lines and transversals.
- Have students use straws or long pieces of licorice to visualize parallel lines and transversals before using the software.
- Use patty paper to verify congruent angles.
- In a “Think-Pair-Share” activity, have students pair up: One student draws lines with transversals, and the other tries to determine whether or not the lines are parallel.
- In a “Think-Pair-Share” activity, have students pair up and find examples of parallel lines, different angles, etc., in the classroom. Then have them share their findings with the rest of the class.
- Arrange for students to visit a construction site to see how plumb lines are used to make vertical lines from which parallel lines can be drawn and to see how angles are used in construction.
- Invite an architect, carpenter, or builder to visit the classroom to discuss the importance of geometry (specifically lines and angles in this case) in the construction industry.
- Ask students to go out into the community and find examples of parallel lines and angles (both complementary and supplementary). They can either draw them or take photographs of them to share with the class.
- Have students paste vocabulary words with illustrations onto $8\frac{1}{2}$ x11 sheets of paper in their notebooks.
- Have students collect the assignments and activities that relate to a particular concept and file them together in their notebooks.

Activity Sheet 1: Lines and Angles

Name _____ Date _____

We're going to explore pairs of angles. Start a new sketch in a dynamic geometry software package, following the steps below.

1. Draw a line containing two points. Name the points A and B .
2. Draw a point not on that line. Label it C .
3. Construct a line through C parallel to \overleftrightarrow{AB} .
4. Construct \overleftrightarrow{BC} .
5. Draw and label points $D, E, F, G,$ and $H,$ as shown on the diagram at the right.
6. Measure the angles listed below.



$m\angle DCE =$ _____	$m\angle ECF =$ _____
$m\angle BCD =$ _____	$m\angle BCF =$ _____
$m\angle ABC =$ _____	$m\angle GBC =$ _____
$m\angle ABH =$ _____	$m\angle GBH =$ _____

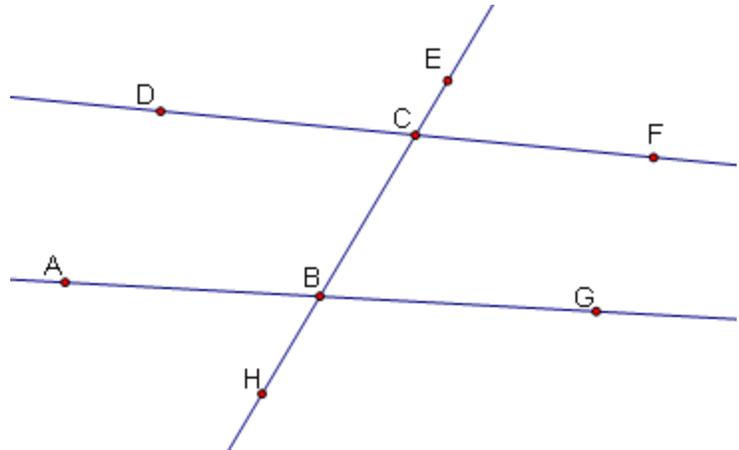
7. List the pairs of angles whose measures add up to 180° .
8. List the pairs of angles that are congruent.
9. Is there any relationship between the measures of angles $\angle DCE$, $\angle ECF$, $\angle BCD$, and $\angle BCF$ and the measures of angles $\angle ABC$, $\angle GBC$, $\angle ABH$, and $\angle GBH$?
10. Save your file as "parallellines" in your geometry folder.

Activity Sheet 2: Lines and Angles

Name _____ Date _____

Start a new sketch in a dynamic geometry software package, following these steps:

1. Draw a line containing two points.
Name them A and B .
2. Draw two points not on the line \overleftrightarrow{AB} .
Label them C and D . (Both points should be on the same side of \overleftrightarrow{AB} .)
3. Construct the line \overleftrightarrow{CD} .
4. Construct \overleftrightarrow{BC} .
5. Draw and label points $D, E, F, G,$ and $H,$ as shown on the diagram at the right.



6. Measure the angles listed below.

$m\angle DCE =$ _____	$m\angle ECF =$ _____
$m\angle BCD =$ _____	$m\angle BCF =$ _____
$m\angle ABC =$ _____	$m\angle GBC =$ _____
$m\angle ABH =$ _____	$m\angle GBH =$ _____
7. List the pairs of angles whose measures add up to 180° .
8. List the pairs of angles that are congruent.
9. Is there any relationship between the measures of angles $\angle DCE$, $\angle ECF$, $\angle BCD$, and $\angle BCF$ and the measures of angles $\angle ABC$, $\angle GBC$, $\angle ABH$ and $\angle GBH$?
10. What is the difference between the angles and lines in Activity Sheet 1 and this activity sheet?
11. Save your file as “nonparallellines” in your geometry folder.

Activity Sheet 3: Lines and Angles

Name _____ Date _____

Use the diagram you formed in Activity Sheet 1 to complete the following:

1. Name all pairs of vertical angles.
2. Name all linear pairs.
3. Name all pairs of corresponding angles.
4. Name all pairs of alternate interior angles.
5. Name all pairs of alternate exterior angles.
6. Name all pairs of consecutive interior angles.
7. Which pairs of angles are congruent, and which are supplementary in 1–6 above? Are the same pairs of angles congruent or supplementary in Activity Sheet 2?
8. Make conjectures (predictions) about when angle pairs will be congruent or supplementary.
9. Rewrite each conjecture in “If..., then” form. For example, “If two parallel lines are cut by a transversal, then corresponding angles are congruent.” “If the measures of two angles add up to 90° , then those angles are complementary.” “If two angles are vertical, then they are”