Angle Relationships

ID: 8670

<div align="right">

Time required
45 minutes

</div>

Activity Overview

In this activity, students explore the angle relationships that exist when two lines intersect. They begin by exploring vertical angles and linear pairs, and then expand their study to two lines and a transversal. They will see what relationships hold true when the two lines intersected by a transversal are parallel, and then use their newly gained knowledge to find missing angle measures in diagrams, using the device's tools to confirm their results.

Topic: Points, Lines & Planes

- *Measure the angles of two intersecting lines to discover that vertical angles have equal measure and adjacent angles are supplementary.*

- *Construct two parallel lines and an intersecting transversal and measure the angles to discover that pairs of alternate angles (interior and exterior) are equal and same side angles (interior and exterior) are supplementary.*

Teacher Preparation

- *This activity is designed to be used in a high-school geometry classroom. It can also be used with advanced middle school students.*

- *The angle relationships explored in this activity span from vertical angles all the way to parallel lines and transversals, including diagrams with more than one pair of parallel lines and more than one transversal. For more experienced students, you may wish to skip problem 1. For less experienced students, you may wish to skip problem 3 or use it as enrichment.*

- *Students should already be familiar with parallel and perpendicular lines as well as reading and naming angles.*

- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*

- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "8670" in the keyword search box.***

Associated Materials

- *AngleRelationships_Student.doc*
- *AngleRelationships.tns*
- *AngleRelationships_Soln.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Vertical and Adjacent Angles (TI-Nspire technology) — 10894*
- *Alternate Interior Angles (TI-Nspire technology) — 13165*

Problem 1 – When two lines intersect

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

On page 1.2, students estimate the measure of ∠ACD and then measure it by using the **Angle** tool (**MENU > Measurement > Angle**). Once the **Angle** tool is selected, the angle is measured by selecting a point on one side of the angle, the vertex point, and then a point on the other side of the angle. In this case, students can select points *A*, *C*, and *D*, in that order.
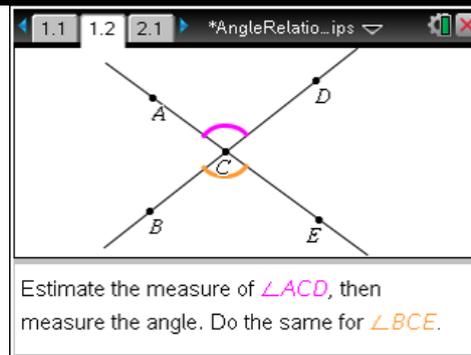
Next, students estimate and measure ∠BCE to find that its measure is equals the measure of ∠ACD. Have students grab and move point *C* to see that this is always true.
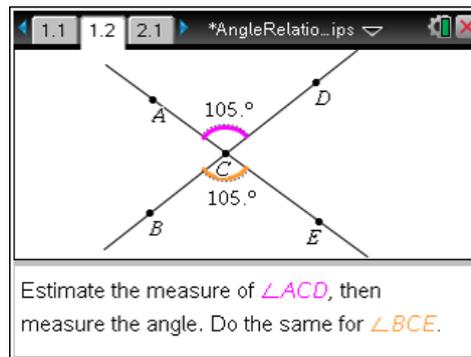
Discuss that these angles are called ***vertical angles*** and vertical angles are always congruent. Since they are congruent, they have the same measure.

Discuss students' predictions for the measures of ∠ACB and ∠DCE. Depending on their background, they may already be aware that two angles that form a straight line are supplementary. Review or introduce the term *linear pair*. Have students display the measures of ∠ACB and ∠DCE.
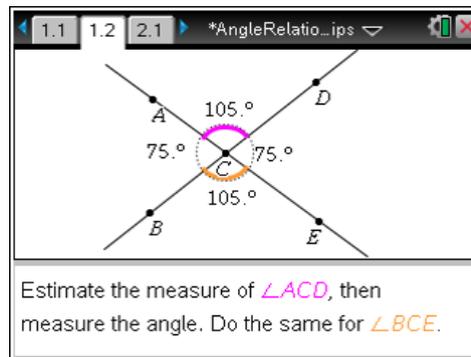
Again, students should grab and move point *C* to see that the measures of both pairs of vertical angles are always equal and that all linear pairs remain supplementary.

TI-Nspire Navigator Opportunity: *Screen Capture*

**See Note 2 at the end of this lesson.**

As an option, you can have students use the **Text** tool (**MENU > Actions > Text**) to display the expression **a + b** and then use the **Calculate** tool (**MENU > Actions > Calculate**) to show the sum of two adjacent angles. This will allow students to more readily see that sum of the measures of the linear pairs is, in fact, always 180°.
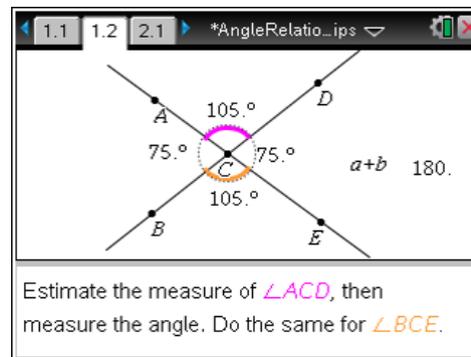
### Problem 2 – When a line intersects two other lines

The diagram on page 2.1 shows two lines, *AF* and *BG*, being intersected by another line, *CH*. Tell students that a line that intersects two or more lines is called a ***transversal***.

The measures of the eight angles formed by the two lines and the transversal are displayed. Point out how all of the pairs of vertical angles have equal measures and all of the linear pairs are supplementary. Be sure students observe that measures of the angles formed by lines *AF* and *CH* differ from those formed by lines *BG* and *CH*.
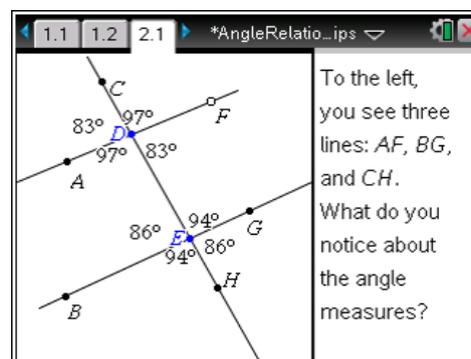
Allow students to explore this model. They should drag point *F* to move line *AF* until ∠*CDF* has the same measure as ∠*DEG*. Ask them to specifically pay attention to what appears to be true about lines *AF* and *BG* when these two angles are congruent. (The lines appear to be parallel.)

Have students identify other pairs of congruent angles when the two lines are parallel (aside from the vertical angles). They should also find supplementary angles (not including linear pairs).
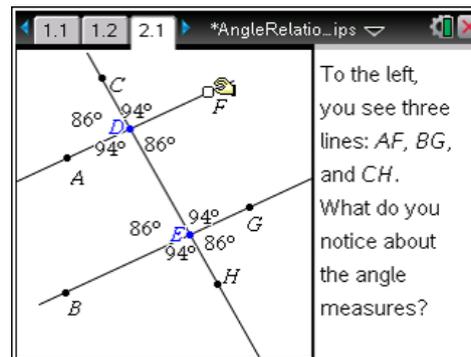
On page 3.2, the relationships among angles formed by parallel lines and a transversal will be examined. In this diagram, lines *AF* and *BG* are parallel. Students can move point *F* to move line *AF* and see that line *BG* will also move to remain parallel to it.
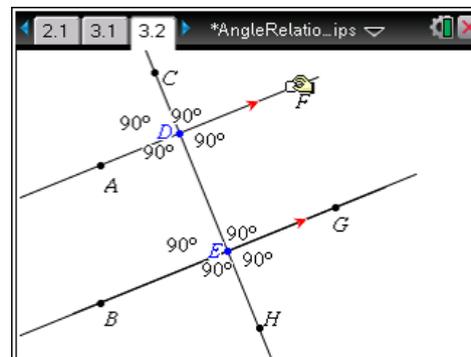
Students can use the **Hide/Show** tool (**MENU > Actions > Hide/Show**) to hide all measurements except for the measures of ∠*CDF* and ∠*DEG*. To use the **Hide/Show** tool, simply click on the measures they wish to hide, and then press the **Escape** key (⎋).

The **Hide/Show** tool is being used here merely to eliminate distractions. You can choose to not use it.

If needed, explain that ∠*CDF* and ∠*DEG* are **corresponding angles**. Have students move point *F* to drag line *AF* to see that corresponding angles formed by two parallel lines and a transversal are always congruent.

Ask students to name the other three pairs of corresponding angles.

Students should now hide all the angle measures except for ∠*ADE* and ∠*DEG*. Explain that these are called **alternate interior angles**. Discuss why the name is fitting. Like before, they should explore by dragging line *AF* to see that they are always congruent when the lines are parallel.

Repeat for **alternate exterior angles**, such as ∠*CDF* and ∠*BEH*.
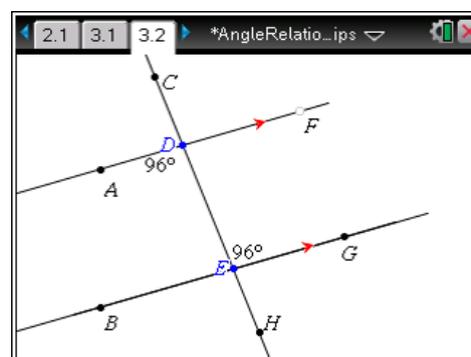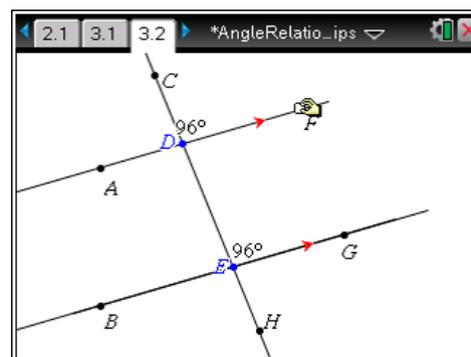
Next, look at a pair of *same-side interior angles*, such as angles ∠FDE and ∠GED. These are always supplementary.

If desired, students can use the **Text** tool as used in Problem 1 to see that the sum of same-side interior angles formed by two parallel lines and a transversal is always 180°.

Note that the same holds true for *same-side exterior angles*, such as ∠CDF and ∠HEG.
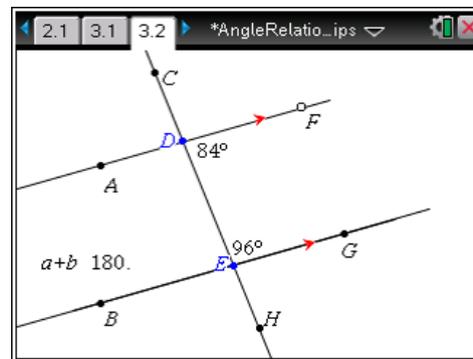
Problem 3 – Putting it all together

The diagram on page 4.2 is also shown on the student worksheet and $m∠FGC = 145°$. Students are prompted to find the requested angle measures, first using only paper and pencil. They can then check their work by measuring the angle measures on the device.

Make sure that students can justify their measurements. Answer any questions students might have about how to find a certain angle measure.
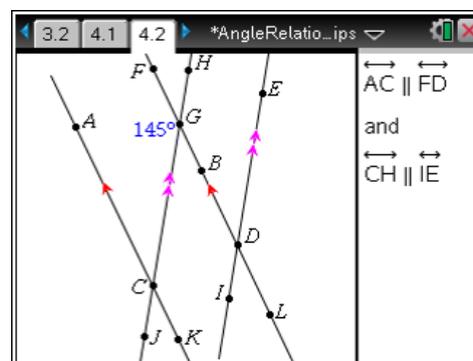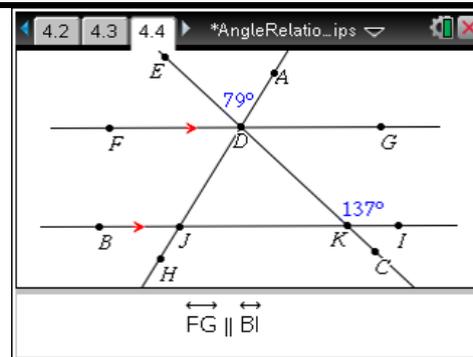

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

On page 4.4, two angle measures are given. Again, students need to find the requested angle measures on their worksheet only and then check their work by measuring the angles.

Discuss and explain the results as needed.

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

Note 1
Problem 1, *Quick Poll*
You may choose to use Quick Poll to assess student understanding. The worksheet questions can be used as a guide for possible questions to ask.

Note 2
Problem 2, *Screen Capture*
You may want to use screen capture to verify students are able to measure all of the angles.