# Can You Follow Instructions?
# An Application of Congruence

**Lesson Plan**

**Cube Fellow:** Sara Golebiewski **Teacher Mentor:** Jessica Bacca

**Goal:** The primary goal of this lesson is to use knowledge of congruent triangles to determine a distance without measuring. Another very important goal (not just for mathematics) is to learn how to ask good questions and to critique instructions.

**Grade and Course:** 8th grade algebra (or other math course)

**KY Standards:** MA-08-3.1.4 (Geometry)
*Students will:*

- *provide examples of congruent and similar figures;*
- *apply congruent and similar figures to solve real-world and mathematical problems and*
- *apply proportional reasoning to solve problems involving scale drawings and proportional figures.*

**Objectives:** Students will learn:

- One way in which to practically use congruent triangles, i.e., finding a distance without measuring it.
- To pay close attention to instructions they are given, and to question the instructions.
- To ask good questions using enough detail and proper mathematical language.

**Resources/materials needed:**

Notebook paper
*Connected Mathematics 2: Kaleidoscopes, Hubcaps, and Mirrors*
Overhead projector and several transparencies to write on (a chalkboard will also work, but will be less convenient)

**Description of Plan:**

Students should be familiar with the congruence of triangles, especially the ways in which we can be sure two triangles are congruent. (The students should also be familiar with symmetry transformations, or else the teacher will need to adapt or omit the final question.)

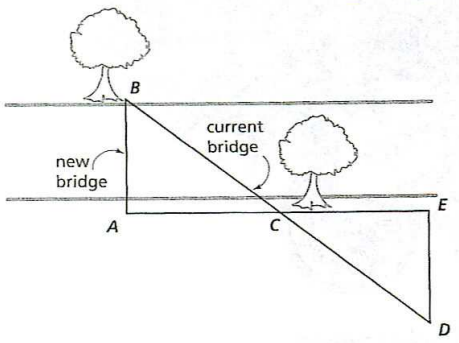
It is VERY IMPORTANT that the students do not see the diagram below (from page 66 in the *Connected Mathematics* book) until the proper time!!!

In this investigation, you will apply what you have learned about congruent polygons, symmetry, and symmetry transformations to solve problems.

## 4.1 Finding Distances Without Measuring

An engineer is planning a footbridge across a river. Currently, there is an old cable bridge strung between two trees on opposite sides of the river (points *B* and *C*). The engineer wants the new bridge to start at one of the trees (point *B*) and span the shortest distance across the river (to point *A*). She needs to figure out how long the new bridge must be.

Her notebook includes the following sketch and instructions:




Take the old cable bridge down. Lay the old bridge on the ground from point C to point D so that points B, C, and D lie in a straight line.

Place a stake at point A directly across the river from point B.

Place another stake at point E so that points A, C, and E lie in a straight line.



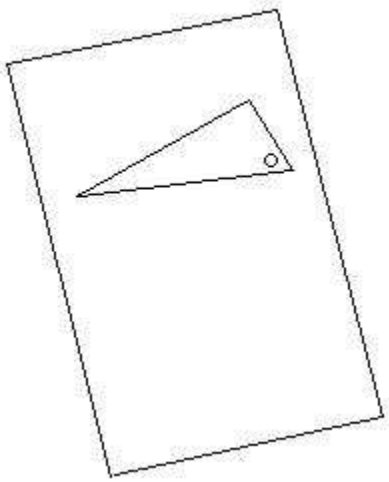
The students get out their notebooks for a fun activity. They should not know what is coming, and the atmosphere should be relaxed. The teacher

writes down three to five instructions one at a time for the students, and the students should follow these instructions to come up with a figure that the teacher has previously drawn but kept secret. (An example is included below, but the possibilities are endless!) The students should work individually. If a student asks a question about an instruction, the teacher answers, but with as little information as possible to give a true response. The teacher does not ask for questions, though.

EXAMPLE:

1. Draw a right triangle.
2. Put a circle inside the right triangle.
3. Draw a rectangle outside the right triangle.

Actual figure:



When the students are finished, with pencils DOWN, the teacher announces that any student whose figure matches the original receives some sort of prize, maybe extra credit. Then the teacher reveals the figure. The key to this is keeping the instructions simple but ambiguous so that no student will come up with the same figure (without requesting much clarification, that is). The teacher should be prepared to reward the students if necessary.

So now the students will say that this is unfair, that the instructions were not good enough. And the teacher agrees – but points out that the students were not forbidden to ask questions! A short discussion should follow, including examples of questions that *should* have been asked.

Now the students should be willing and ready to ask questions, at least for the rest of the day. The teacher explains the premise of the next similar

activity (explaining about the engineer from the scanned page above). The teacher shows the students a picture of the river, two trees, and current bridge (with points labeled B and C) ONLY. He/she reveals the engineer's instructions to the students one at a time, and they ask as many questions as they feel they need to draw the figure. They draw their figures individually, and the teacher does not point out any mistakes at this time. After all three instructions have been read, the teacher and students redo the activity as a team. The students should begin their drawing anew, so they may examine any errors in their first drawing.

If the students are using *Connected Mathematics 2* books, they may open them now, but the teacher needs to explain that they did not complete the activity as it is written. In the *Kaleidoscopes, Hubcaps, and Mirrors* lesson, there are four parts to Problem 4.1, and they need only be altered slightly. Here are the parts, in an order more natural to the above approach to the lesson:

1. Were the engineer's instructions clear? If not, what additional information should she have provided?

2. a. What do you notice about the two triangles in the figure?
   b. Which sides and angles in the two triangles are congruent?
      (Note: This answer may vary depending on the questions the students asked. We certainly know that BC = CD and m<ACB = m<ECD. And then we either know that both <A and <E are right angles, OR that AC = CE.)
   c. What can we conclude?

3. How can we determine the distance across the river without literally measuring it?

4. (optional tie-in to previous topics) What transformations or combination of transformations would match one of the triangles to the other? (taken directly from the text)

**Lesson Source:**

*Connected Mathematics 2: Kaleidoscopes, Hubcaps, and Mirrors*
(© 2006 Michigan State University)
Lesson 4.1: *Finding Distances Without Measuring* (pp. 66-67)

Original adaptation of above lesson, inspired by an illustration given on the cube's first day of ninth grade social studies. (You made your point Mr. Gilmore!)

**Instructional Mode:** Interactive discussion/activity

**Date Given:** March 8, 2007

**Estimated Time**: 45 minutes

**Date Submitted to Algebra$^3$:** July 4, 2007

Form 8-18-06