Math Objectives

- Students will identify corresponding parts of similar figures.
- Students will apply what they know about similar figures to solve real-world design problems.

Vocabulary

- similar
- corresponding parts

About the Lesson

- In this lesson, students use similar figures to solve real-world applications. In Problem 1, students use similar rectangles to enlarge a photo. In Problem 2, students use similar triangles to estimate the height of a building.

As a result, students will:

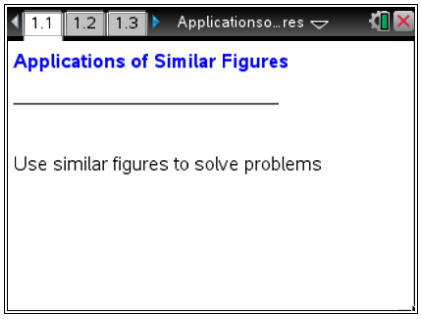
- Use the definition of similarity to decide if two figures are similar.
- Model with geometry and apply the principle of similar figures to solve design problems.
- Explain the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

TI-Nspire™ Navigator™ System

- Send out the *ApplicationsofSimilarFigures.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- ApplicationsofSimilarFigures_Student.pdf
- *ApplicationsofSimilarFigures*_Student.doc

TI-Nspire document

- ApplicationsofSimilarFigures.tns

Discussion Points and Possible Answers

Teacher Tip: It may be helpful to show students a few pictures of objects that were not enlarged/reduced proportionally to illustrate the need for identical ratios. If possible, show a picture whose width (but not length) was enlarged correctly, as in Problem 1.

Problem 1 – Similar Rectangles

The photo problem is presented to the students on their student activity sheets.

Students should answer the question and check their work.

1. Suppose you have a 4 in by 5 in photo that you want to enlarge for an album. You would like the enlarged picture to take up almost an entire page of a 7 in by 10 in album, leaving some space at the top for a picture title. What will have to be true about the picture and the enlargement so you do not distort the picture?

   Answer: The ratio of the lengths should be kept the same in order for the shapes to be similar.

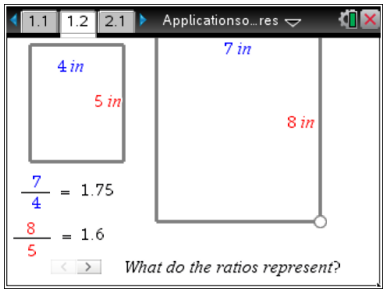
Teacher Tip: Mathematically proficient students should try to communicate their answers precisely with other students. Vocabulary is important when attending to precision. This activity will also give students an opportunity to be careful about specifying units of measure.

TI-Nspire Navigator Opportunity: *Quick Poll*

Send this question as a Quick Poll. Use this as the 'bell ringer.'

2. On page 1.2 there are two rectangles. One rectangle represents the picture and the other rectangle represents the enlargement. What do the ratios represent? Answer questions 2-4 before moving the open point.

   Answer: The ratios represent the lengths of corresponding sides of the two rectangles.



Tech Tip: Use tab to select the slider. Then, use the arrows to work through the instructions on page 1.2.

3. Are these rectangles similar? Explain.

   Answer: No. These rectangles are not similar because the ratios of corresponding sides are not equal.

4. How does the ratio of the heights of the pictures compare with the ratio of the widths? What should these ratios be for similar rectangles?

   Answer: The ratio of the widths of the two pictures equals 1.75, and the ratio of the heights is 1.60. In order for the rectangles to be similar, these ratios must be the same.

On page 1.2, students should grab and drag the open circle at the lower-right corner of the larger rectangle until the height ratio is equal to the width ratio.

Tech Tip: If students experience difficulty dragging the point, check to make sure that they have moved the arrow until it becomes a hand (☜) getting ready to grab the point. Press ctrl to grab the point and close the hand (☜). Press esc to release the point or deselect other objects.

Tech Tip: If students experience difficulty grabbing and dragging a point, have them tap and hold the desired point for a few seconds and then drag the point to the desired location.

5. Drag the open circle of the larger rectangle until the ratios are equal. What does the height of the larger rectangle need to be in order for the rectangles to be similar? How much space will be left at the top of the 7 x 10 inch page for the picture title?

   Answer: The height of the enlarged picture should be 8.75 inches. Because the album is 10 inches high, this leaves 1.25 inches for the picture title.

Tech Tip: select ctrl Z to undo an action; select ctrl Y to redo an action.

Tech Tip: Select the undo/redo icon to undo an action; select and hold on the icon and select **Redo** to redo an action.

Problem 2 – Similar Triangles

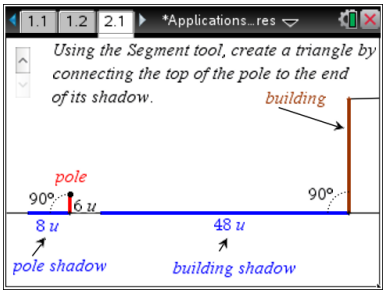
Students are presented with the following historical reference on their handout:

The Greek mathematician Thales found a way to use similar triangles to estimate the height of a pyramid in Egypt by placing a rod at the tip of the pyramid's shadow.

You decide to use the same method to find the height of a building. You will be painting the building and need to estimate the amount

of paint needed for the project.

The diagram on page 2.1 shows a 6 unit tall pole that was placed near the tip of the shadow of the building. Have students select the up arrows for step-by-step directions.



6. On page 2.1, use the **Segment** tool (**MENU > Geometry > Points & Lines > Segment**) to create two triangles by connecting the top of the pole to the end of its shadow and then the top of the building to the end of its shadow. How do the corresponding angles in the two triangles compare?

   Answer: The corresponding angles of the two triangles are the same, since they both form a 90° angle with the ground and the angle rays of the sun makes with the ground will be the same in both triangles. Therefore, if two angles are the same in both triangles, the third angles must also be the same.

   Teacher Tip: Student answers may vary. The point of this question is to help students recognize that two of the corresponding angles between the triangles are congruent. Therefore, all three angle measures in both triangles are the same.

TI-Nspire Navigator Opportunity: *Class Capture and Live Presenter*
See Note 1 at the end of this lesson.

7. Use the **Angle** tool (**MENU > Geometry > Measurement > Angle**) to find the angle measures of the other four angles in the triangles. (When finding the measure of an angle, the second point is the vertex of the angle you want to measure.) How do these measures compare to your response to Question 6? Can the angle measures be used to determine if the triangles are similar?

   Answer: Student answers may vary. According to the definition of similar figures, ratios of all pairs of corresponding sides are equal and all corresponding angles are congruent. For this "3-4-5" triangle, the measure of the angles are 36.7º and 53.3º. If students did not get these angle measures, they may not have selected the vertex point.

   Teacher Tip: This question could also be a good way to introduce the AA similarity postulate for triangles.

8. What is the ratio of the length of the pole and its shadow? What will be the ratio of the height of the building and its shadow?

   Answer: The ratio of the length of the pole and its shadow is $\frac{6}{8}$, or 0.75. The ratio of the height of the building and its shadow should also be 0.75.

9. Using what you know about similar figures, find the height of the building. Explain your reasoning. Check your solution by using the **Length** tool (**MENU > Geometry > Measurement > Length**) to find the height of the building. (Assume the units of the length measurements are in feet.)

   Answer: The ratio of the height of the building and its shadow must equal 0.75, so *h*/48 = 0.75. Solving for *h* means that the building must be 36 feet high.

> **Teacher Tip:** Students may find the height of the building by using guess and check with ratios or by setting up and solving a proportion.

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Note 1

Class Capture and Live Presenter

Use the Class Capture tool to make sure student are progressing well. Live Presenter can be used to demonstrate to the class how to grab the point, or include additional tech tips such as using tab to select the slider. Students can also demonstrate their strategy to solve question 9.