Supertall Skyscrapers

ID: 8679

Time required
45 minutes

Activity Overview

In this activity, students measure scale drawings of famous "supertall" skyscrapers. They first check that the Sears Tower is drawn to scale by verifying that two expressions form a proportion. Then, they use the measurements to calculate the scale of the drawing. Next, they write and solve more proportions to find the heights of other skyscrapers drawn with the same scale. The handheld's functionality for changing the scale of a drawing is introduced. The students will create an accurate scale model of themselves within one of the scale drawings.

Topic: Linear Equations

- *Use cross-multiplication to solve for any variable in a proportion.*

Teacher Preparation and Notes

- *This activity is designed for use in an Algebra 1 or Pre-Algebra classroom. Prior to beginning the activity, students should have some experience verifying and solving proportions. Before the activity you may choose to share the following information to generate interest:*
  - *The Sears Tower (Willis Tower), located in Chicago, is the tallest building in the U.S. The high definition television antennae, placed there by helicopter in 2000, make it the world's tallest building by 'tip height'. Its elevators move at 1,600 feet per minute. It has 108 floors. Over 1.5 million people visit the observation deck every year.*
  - *The Taipei 101, located in Taiwan, held the title for the World's Tallest Building for several years. The building has 101 floors and construction was completed in 2004. In this activity, students will discover the height of the Taipei 101.*
  - *This activity is intended to be completed individually, with brief periods of teacher-led, whole class discussion. Use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds.*
- *All images used in the TI-Nspire documents are freely licensed content from Wikimedia Commons.*
- *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 "8679" in the keyword search box.***

Associated Materials

- *Skyscrapers_Student.doc*
- *Skyscrapers.tns*
- *Skyscrapers_Soln.tns*

Suggested Related Activities

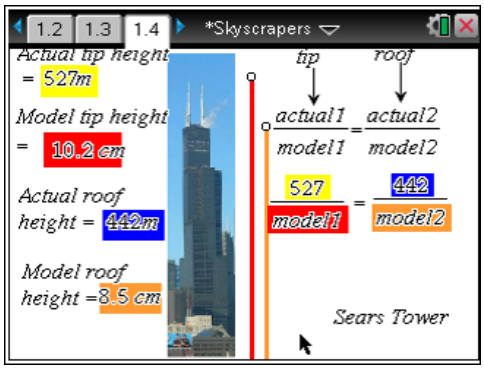
To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Ratios of Similar Triangles (TI-Nspire technology) — 11060*
- *Math TODAY: Wing Tabs Save Fuel (TI-84 Plus family) — 7645*

A scale drawing is an enlarged or reduced drawing that is similar to an actual object or place. Blueprints and maps are examples of scale drawings. The ratio of a distance in the drawing to the actual distance it represents is the scale of the drawing.

Problem 1 – Verifying that a drawing is to scale

Students begin by measuring the roof height and the tip height of the Sears Tower, now called Willis Tower. Demonstrate dragging the point until the line segment is the same height as the building and measuring its length with the **Length** tool (**Measurement > Length**). Students should use one segment to measure the tip height of the building, including the antennae, and the other to measure the roof height (without antennae).



The next step is verifying that the heights form a proportion by evaluating each side of $\frac{527}{model1} = \frac{442}{model2}$ with the **Calculate** tool (**MENU > Tools > Calculate**), choosing the correct values for *model1* and *model2*, and checking to see that they are equal. These calculations may be performed directly on the *Geometry* page.

Discuss the accuracy of the model with students. Have students adjust their line segments to make the two sides of the proportion as close to equal as possible. Once they are satisfied with the measurements, help students write and solve a proportion to find the scale of the drawing.

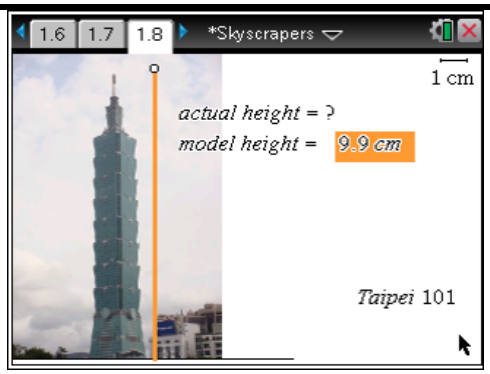
$$\frac{527 \text{ m}}{10.25 \text{ cm}} = \frac{x \text{ m}}{1 \text{ cm}}$$

$$1 \text{ cm} \approx 51.4146 \text{ m}$$

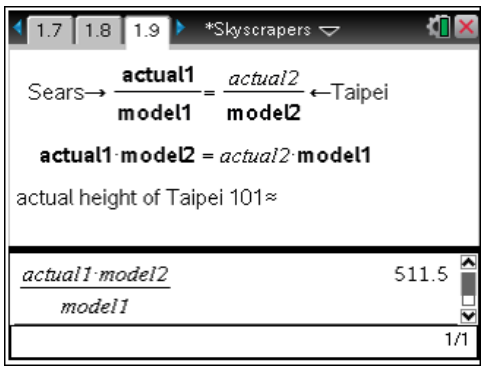
TI-Nspire Navigator Opportunity: *Screen Capture*

See Note 1 at the end of this lesson.

Students then solve more proportions to find the height of the Taipei 101 and Empire State Building, based on the measurements they have for the Sears Tower. Again, they drag the point to adjust the height of the line segment and measure its length.



Students solve the proportion on page 1.9. Discuss the meaning of each variable (*actual1* is the actual height of the Sears Tower, *actual2* is the actual height of Taipei 101, etc.). Then instruct students to return to page 1.4 and collect the value of *actual1* by moving the cursor over it and pressing var, selecting **Store**, and replacing **var** with **actual1**. Repeat to store the value of *model1*. Advance again to page 1.8 and store the value of *model2*.

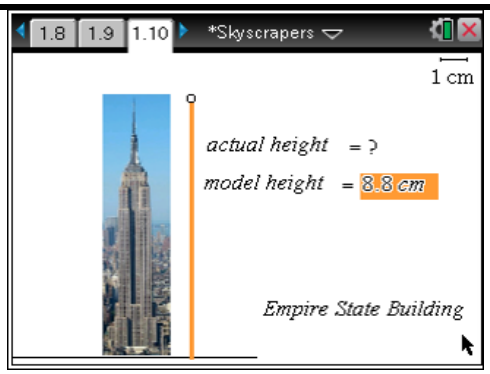


Return to page 1.9 and discuss how cross multiplication transformed the proportion into the linear equation below it. Students should then use the *Calculator screen* to solve the equation by whatever method they wish.

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 2 at the end of this lesson.

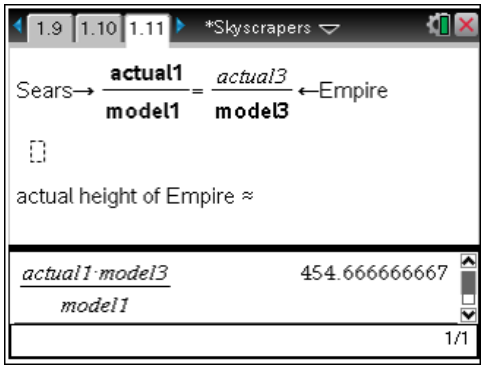
On page 1.10, students repeat the process to find the height of the Empire State Building. Students should only collect the value of *model3*. There is no need to collect the values of *actual1* and *model1* again. When they advance to page 1.11, students can use the *Calculator* application to find the value of *model3*, as before.



Student Solutions

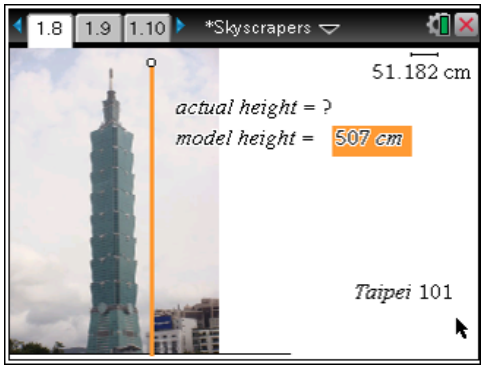
Actual height of the Taipei 101: 508 m

Actual height of the Empire State Building: 449 m



Problem 2 – Changing the scale

Tell students that they can use their handhelds to change the scale of the drawing and all the measurements will update automatically.

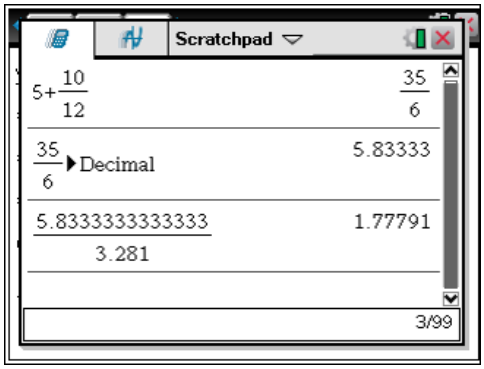


Students should display the scale (**MENU > View > Show Scale**) and change 1 cm to the scale they calculated in Problem 1. The measurements on the screen now show the actual height. Students should use them to check their answers from Problem 1.

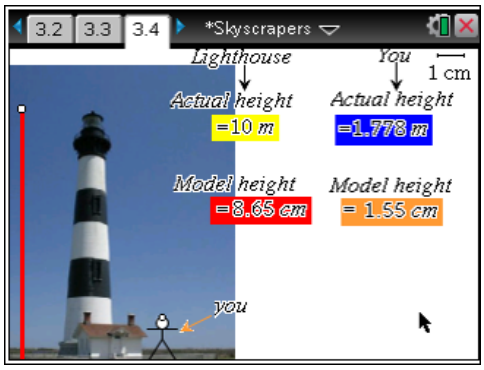
Discuss reasons why the answers may not be exact (e.g., slight variations in the length of the line, rounding, etc.).

Problem 3 – Are you to scale?

On page 3.2, students use the *Sketchpad* and *Notes* screens to calculate and record their height in feet (as opposed to feet and inches). They should then write and solve a proportion to find their height in meters.



Page 3.4 shows a new scale drawing, with a larger scale than the skyscraper drawings. Students again drag a point on a line segment to find the height of the lighthouse (the length is already measured) and then write and solve a proportion to find the correct length to represent their height in this drawing. Students can then drag the point on the top of the figure to the correct height.



Students should then check their answers by changing the scale, as they did in Problem 2, and confirming that their height is correct.

TI-Nspire Navigator Opportunities

Note 1
Problem 1, *Screen Capture*
This would be a good place to do a screen capture to verify students have used the Calculate tool correctly to find the scale of the drawing. If some students were not able to get it, use *Live Presenter* and show the class how to do it.

Note 2
Problem 1, *Quick Poll*
You may choose to send a Quick Poll asking students to submit their answer for the actual height of Taipei 101 once they have solved the proportion on page 1.9. This can be repeated for the proportion on page 1.11.