

## Dilations with Matrices

ID: 11482

Time Required  
15 minutes

## Activity Overview

*In this activity, students will use matrices to perform dilations centered at the origins of triangles. Students will explore the effect of the scale factor on the size relationship between the preimage and image of a polygon.*

## Topic: Dilations

- *Matrix multiplication*

## Teacher Preparation and Notes

- *The extension at the end of this activity is a continuation of the extension problem from the activity Triangle in the Matrix (11400). Download and review the activity, if needed, to complete the problem before using the extension in this activity.*
- *Teachers should practice completing a dilation on the handheld before using the activity. See Related Activity Dilations (8487) for directions.*
- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter "11482" in the keyword search box.***

## Associated Materials

- *DilationsWithMatrices\_Student.doc*
- *DilationsWithMatrices.tns*

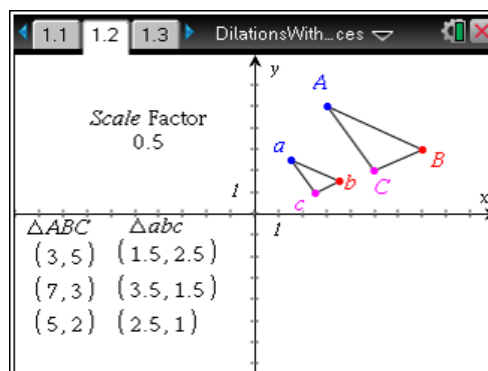
## Suggested Related Activities

*To download any activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the keyword search box.*

- *Dilations (TI-Nspire Technology) — 8487*
- *Scale Factor (TI-Nspire Technology) — 8299*
- *Transformations with Lists (TI-Nspire Technology) — 10278*

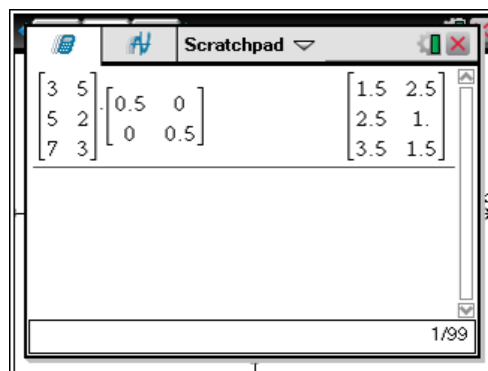
### Problem 1 – Dilation Example

In Problem 1, students will examine the coordinates of the preimage and image of a triangle and recall properties of vertices under dilation. Students will read notes on creating a dilation matrix and then use matrix multiplication to find the image vertices.



#### Discussion Questions:

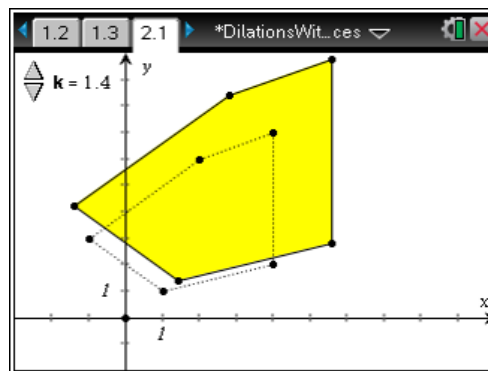
- Why is the dilation matrix second in the multiplication process?
- Why do we use zero instead of one in the dilation matrix?
- What happens if we switch the position of the scale factor and zeroes in the dilation matrix?



### Problem 2 – Scaling Up or Down

On page 2.1, students will use a slider to determine values for the scale factor that make the image of the dilation larger or smaller than the preimage.

Students will then write a matrix multiplication problem for the triangle given on page 2.2 that makes the triangle larger or smaller based on their findings. Students will write their own matrix multiplication and give the coordinates of their new images.

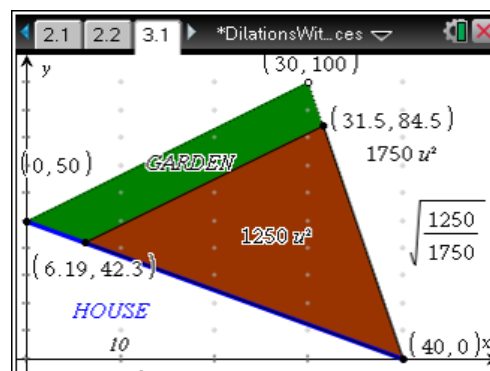


#### Discussion Questions:

- For what values of the scale factor is the image larger than the preimage? Smaller? Equal?
- What happens if the scale factor becomes negative?

**Extension – Fencing a Garden, Part II**

Students are asked to find coordinates of the fence posts of a new garden. Students should be reminded that the scale factor is not equal to the ratio of the garden areas, but it is equal to the square root of this ratio (square root of this number because we need to know the scale for each axis in order to dilate the figure). Students can then use the **Dilation** tool from the Transformation menu to dilate the triangle.

**Student Solutions**

1. Sample answer: image coordinates are half of the value of the preimage coordinates

$$2. \begin{bmatrix} 3 & 5 \\ 5 & 2 \\ 7 & 3 \end{bmatrix} \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix} = \begin{bmatrix} 1.5 & 2.5 \\ 2.5 & 1 \\ 3.5 & 1.5 \end{bmatrix}$$

3. Sample answer: if the scale factor  $> 1$ , the image is larger than the preimage. If the scale factor  $< 1$ , the image is smaller than the preimage

$$4. \text{ Sample answer: } \begin{bmatrix} -7 & -5 \\ -5 & 4 \\ 2 & -6 \end{bmatrix} \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 14 & -10 \\ -10 & 8 \\ 4 & -12 \end{bmatrix}$$

$$5. \text{ Sample answer: } \begin{bmatrix} -7 & -5 \\ -5 & 4 \\ 2 & -6 \end{bmatrix} \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix} = \begin{bmatrix} -3.5 & -2.5 \\ -2.5 & 2 \\ 1 & -3 \end{bmatrix}$$

$$6. \begin{bmatrix} -7 & -5 \\ -5 & 4 \\ 2 & -6 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -7 & -5 \\ -5 & 4 \\ 2 & -6 \end{bmatrix}$$

7. Sample answer: (40, 0), (6.19383, 42.2577), (31.5485, 84.5154)