# Understanding Dilations

**Short description:** Learn how photographers use dilations to print the same photograph in larger or smaller sizes in this Math Shorts video.

**Long description:** In this video, learn how photographers use dilations to print the same photograph in larger or smaller sizes. In the accompanying classroom activity, students consider how dilation is a geometric application of scale factor. After a brief refresher on scale, students watch the video. Then, they apply what they have learned by creating larger and smaller dilations of a picture, using the coordinate plane as their canvas. Students consider how both scale factor and the center of dilation influence the size and placement of the drawings they make.

**Activity Text**

**Learning Outcomes**
Students will be able to

- accurately use dilation to stretch or shrink a geometric shape proportionally
- understand how scale factor influences the size of a dilation
- understand how the center of dilation influences the location of a dilation on the coordinate plane

**Common Core State Standards:** 8.G.A.3

**Vocabulary:** Dilation, proportional, scale factor, center of dilation, origin, similar

**Materials**: Graph paper, rulers, rectangular pictures of varying sizes (4" x 6" and smaller). Note: These pictures should align evenly with whatever graph paper is provided. So if quarter-inch graph paper is being used, then the pictures should be cut to the nearest quarter-inch.

**Preparation:** Print three different-sized copies of one picture: one larger, one smaller, and one stretched so that it is not proportional to the others.

**Procedure**

**1. Introduction (5 minutes, whole group)**
Show the large, small, and stretched pictures to students and ask them to describe the differences among all three. Students should notice that the "look" of the bigger and smaller ones are the same. While the sizes are different, the represented image is not otherwise skewed or stretched. However, the stretched image is different: it does not look like it is of the same family as the other two. Ask students to describe how this image is different from the other two. Explain that in this activity, they will explore the idea of *dilation*, or the *proportional* stretching and shrinking of geometric shapes, on the coordinate plane.

**2. Watch the Video (5 minutes, pairs)**
Divide the class into pairs and show students the video. Following the video, have students briefly discuss these questions:

- What does it mean when two shapes are proportional?
- What is *scale factor*?
- What is the *center of dilation*?

**3. Activity (20 minutes, individuals)**
Pass out a small picture, ruler, and two pieces of graph paper to each student. Students should do the following:

- Use the ruler to draw horizontal and vertical axes on their graph paper (only the first quadrant is needed).
- Place their picture with the bottom left corner at the *origin*. Mark the four corners with the letters A, B, C, D, also noting the (*x*, *y*) pairs.
- Choose a scale factor of 2, 3, or 4.
- Create a dilation of the original picture from (0, 0) using the chosen scale factor and mark the new corners with A', B', C', D', also noting the new (*x*, *y*) pairs.
- Redraw the original picture according to the scale factor.

After students have completed the first drawing, they should repeat the process on another piece of paper using a smaller scale factor: either 1/2, 1/3, or 1/4.

By the end of this activity, students should have two pictures that look *similar* to the original picture, though at substantially different scales.

**Extension:** Students who quickly grasp the idea of dilation may want to try a slightly more complicated take on the scale drawings. Have them place the original picture with the bottom left corner at (2, 2), or any point other than the origin. Then, have them choose a scale factor and create a dilation of the picture from the point (0, 0). How does this change the layout of the picture? Have them repeat the process for a scale factor less than 1. Students who complete this activity may also want to watch the video again.

**4. Conclusion (10 minutes, whole group)**
Ask some students to share their drawings. If any students completed the extension, ask them to share their drawings, too. Use these questions to lead a class discussion:

- What does it mean to dilate a geometric shape?
- How does moving the center of dilation change the placement of the dilation on the coordinate grid?
- How are the ideas of dilation and scale related?

Walk students through two different dilations, one in which the center of dilation is (0, 0), and one in which the center of dilation has moved somewhere else on the coordinate plane. Explore how the placement of the figure changes as the center of dilation changes, while the size and shape of the figure remain the same.