Compose Functions Name:

In this Geometric Functions activity you will dilate one point, translate another point, and then *compose* the two functions (by merging the input of the second to the output of the first.)

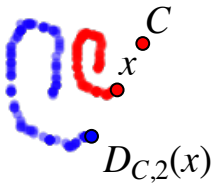
DILATE A POINT

1. In a new sketch, construct independent variable point *x*.
2. Construct a second point and label it *C*.

3. Mark point *C* as the center for dilation by double-clicking it.
4. To dilate point *x,* select it and choose **Transform | Dilate.** The ratio is 1/2. Change it to 2/1. Click **Dilate.**

5. Label the new dependent variable *D[C,2](x)*.

The label appears as $D_{C,2}(x)$. Read this as "the dilation, about *C* by a scale of 2, of variable *x*."



6. Color the new point blue, and turn on tracing for both points.

Q1 Drag independent variable *x* to make an interesting shape. On your paper draw the shapes made by *x* and $D_{C,2}(x)$.

Q2 Describe the behavior of the two points. (In other words, describe the behavior of the function named $D_{C,2}$.)

7. Erase the traces by choosing **Display | Erase Traces.**

TRANSLATE A POINT

8. Construct another independent variable point, and label it *w*.

9. Construct a segment near point *w*. Label its endpoints *D* and *E*.
10. To mark the vector from *D* to *E,* select the two points in order and choose **Transform | Mark Vector.**

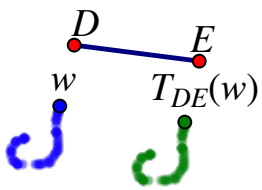
11. To translate point *w,* select it and choose **Transform | Translate.** The vector is from *D* to *E*. Click **Translate.**

12. Label the new dependent variable *T[DE](w)*. It appears as $T_{DE}(w)$.

Read this as "the translation, by the vector from *D* to *E,* of variable *w*."

13. Turn on tracing for *w* and $T_{DE}(w)$.

Q3 Drag independent variable *w* to make an interesting shape. On your paper draw the shapes made by *w* and $T_{DE}(w)$.



Q4 Describe the behavior of the two variables. (In other words, describe the behavior of the function named T_{DE}.)

14. Erase the traces by choosing **Display | Erase Traces.**

COMBINE THE TRANSFORMATIONS

15. Select points $D_{C,2}(x)$ and w, and choose **Edit | Merge Points.**

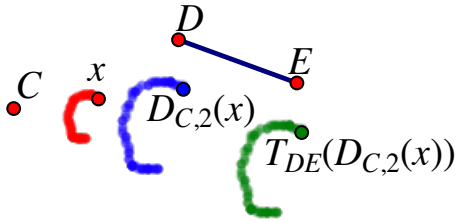
Q5 Describe what happened when you chose this command.

16. The final dependent point is labeled $T_{DE}(w)$, but after merging, point w is now labeled $D_{C,2}(x)$. Edit the label of the final point by changing the w in the label to $D[C,2](x)$.

Q6 The new label appears as $T_{DE}(D_{C,2}(x))$. Explain why this label makes sense, and write down in words how you would read it.

17. Drag x and observe the behavior of the two dependent points.

Q7 Erase the traces, drag point x in an interesting shape, and draw on your paper the shapes traced by all three points.



18. Construct an interesting polygon, with at least 5 vertices, using the **Polygon** tool. To finish the polygon, click again on the first point.

Q8 Predict the range of the composed function. Use the **Marker** tool to draw your prediction on your sketch.

19. Restrict point x to the polygon by selecting both the point and the polygon and choosing **Edit | Merge Point to Polygon.**

20. Erase the traces, and then animate point x by selecting it and choosing **Display | Animate Point.**

Q9 Draw on your paper the traces made by the three points.

Q10 Describe the traces in words. Which points are connected by $D_{C,2}$? Which points are connected by T_{DE}?

ELIMINATE THE INTERMEDIATE VARIABLE

21. Hide point $D_{C,2}(x)$ by selecting it and choosing **Display | Hide Point,** and erase the traces. Then drag again to observe the behavior of the composed function.

EXPLORE MORE

22. In a new sketch combine two other transformations of your choice.