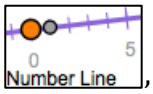
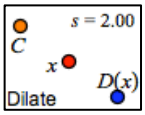
Connect to Cartesian Names:

In this activity you will compose a function on the number line, similar to the Dynagraph construction from a previous activity. However, this time you will make the dependent variable's axis vertical instead of horizontal. This will give you a different way to look at the relative rate of change of your independent and dependent variables.

DILATE

Begin by constructing the input axis.

1. Construct a 

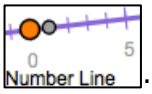
, make it horizontal, and construct a 

function on the number line.

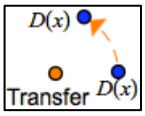
Q1 Each row in this table describes the relative motion of x and $D(x)$. Find a scale factor that creates the given motion, and write it down. Check your result by varying x.

Relative speed	Relative direction	*Scale factor s*
$D(x)$ goes the same speed as x.	$D(x)$ goes the opposite direction as x.	***s* =**
$D(x)$ goes slower than x.	$D(x)$ goes the same direction as x.	***s* =**
$D(x)$ goes the same speed as x.	$D(x)$ goes the same direction as x.	***s* =**
$D(x)$ goes faster than x.	$D(x)$ goes the opposite direction as x.	***s* =**

CREATE THE OUTPUT AXIS

2. Make sure your input axis is horizontal, and add a second 

. Attach the number lines to each other by their origins.

3. Use the 

tool to transfer variable $D(x)$ to the output axis. After you finalize the tool, drag the rotated $D(x)$ all the way to the vertical axis.

Q2 Vary x, and stop at several different places. In the places where you stopped, how does the value of $D(x)$ on the vertical axis compare to $D(x)$ on the horizontal axis?

TRANSLATE

On the vertical axis you'll compose translation with dilation, producing $T(D(x))$.

4. Use the Translate tool to attach $D(x)$ to the point $D(x)$ on the vertical axis, attaching v to the vertical axis.

Q3 For each row of the table below, edit s and drag v and x to the values shown. Then record the values for $D(x)$ and $T(D(x))$.

s	v	x	$D(x)$	$T(D(x))$
2.50	–3.00	–2.00		
–2.00	1.00	–3.00		
0.50	2.50	2.00		

Q4 You will soon be asked whether x and $T(D(x))$ are moving in the same direction or different directions—but x moves left and right, and $T(D(x))$ moves up and down! So you'll need to think about whether the numbers are getting bigger or smaller.

x varies	$T(D(x))$ varies	Is x increasing or decreasing?	Is $T(D(x))$ increasing or decreasing?	Same direction or different?
right	up			
right	down			
left	up			
left	down			

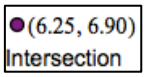
TRACK THE VARIABLES

Now you'll add lines to track the horizontal location of x and the vertical location of $T(D(x))$.

7. Construct a perpendicular to the horizontal line through x. Construct a perpendicular to the vertical line through $T(D(x))$.

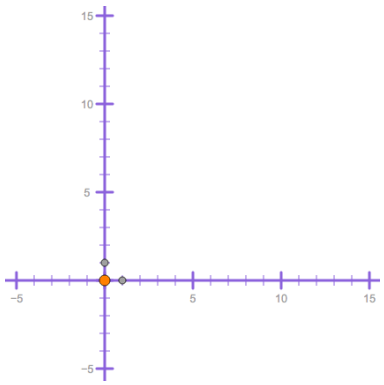
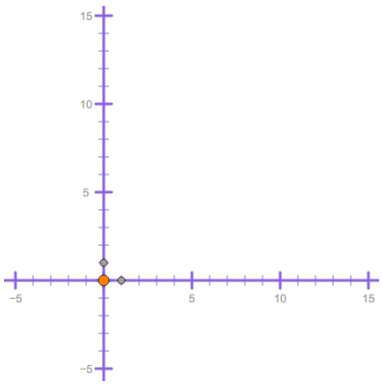
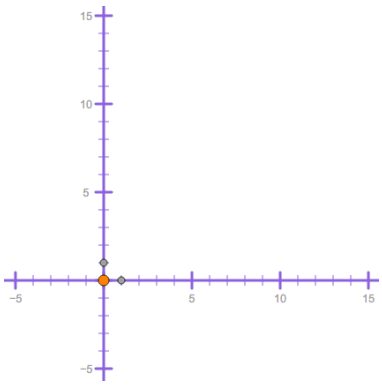
Q5 Drag x. What do you notice about the lines when you vary x?

INVESTIGATE

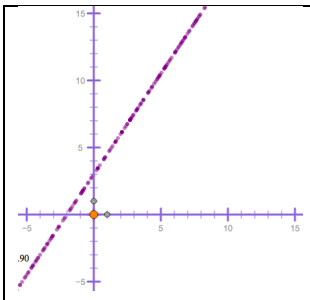
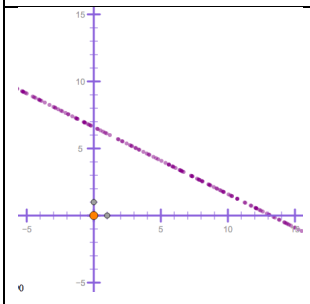
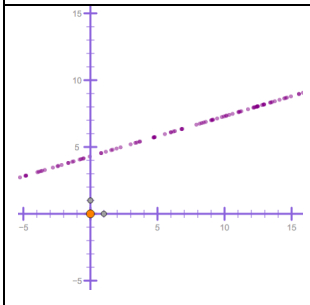
8. Tap the 

tool and use it to construct a point at the intersection of the lines.

Q6 For ***a*** below, set the dilation scale factor (s) and the translation vector (v) as shown. Vary x and draw the shape made by the traced intersection. Then do **b** and **c.**

a	***b***	***c***
$s = 2.0$	$s = -3.0$	$s = 0.5$
$v = -3.0$	$v = 5.0$	$v = 2.0$
		

Q7 For the traces on the left, circle the correct words on the right, and tell how you know.

	$T(D(x))$ is moving **| faster | slower | at the same speed |** as x. $T(D(x))$ is moving in the **| same | opposite |** direction as x. I know this because:
	$T(D(x))$ is *moving* **| faster | slower | at the same speed |** as x. $T(D(x))$ is moving in the **| same | opposite |** direction as x. I know this because:
	$T(D(x))$ is *moving* **| faster | slower | at the same speed |** as x. $T(D(x))$ is moving in the **| same | opposite |** direction as x. I know this because: