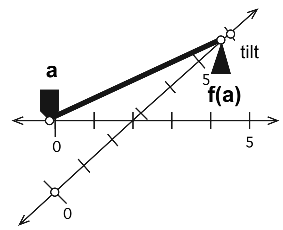
From Dynagraphs to Cartesian Graphs

For GSP5

Dynagraphs make it easy to change the input of a function and see how each input produces a corresponding output. This strength is also a weakness, because you can see only a single pair of input-output values at any time.



In this activity you'll change a dynagraph so that you can keep track of many input and output values at the same time.

FUNCTION MATCHMAKING

Start out with some "function matchmaking"—you'll match several dynagraphs to their corresponding algebraic equations.

The dynagraphs don't show any numbers, so you'll have to figure out each match by observing the output marker as you drag the input marker.

Q1 Open **Dyna To Cartesian.gsp.** The five dynagraphs on page 1 correspond to the equations below. Pair each dynagraph with an equation and explain how you made the match.

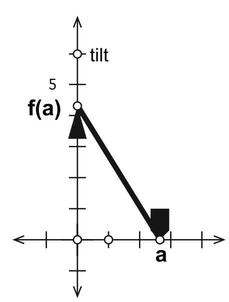
a. $y = x$ b. $y = -x$ c. $y = 2x$

d. $y = x^2$ e. $y = \dfrac{1}{x-1} + 1$

FROM DYNAGRAPHS TO CARTESIAN GRAPHS

1. On page 2 of **Dyna To Cartesian.gsp,** you'll see a dynagraph for the function $f(x) = 2x - 1$. Drag the input marker to familiarize yourself with this function.
2. Drag the point labeled *tilt* so that the output axis is at an angle to the input axis. Drag the input marker again. Do this for a few different angles of the output axis. (You can even turn it upside down!)

Q2 When you tilt the output axis, what changes and what remains the same?



3. Press the *Make Cartesian* button and watch as the two axes of your dynagraph "morph" into the familiar x- and y-axes. Drag the input once more to convince yourself that you're still dealing with the same dynagraph, only tilted.
4. Press the *Show Perpendiculars* button to show lines through a and $f(a)$ perpendicular to the two axes.

Click the intersection to construct the point of intersection.

5. Construct the intersection of the two perpendiculars.
6. With the new point selected, measure its coordinates by choosing **Measure | Coordinates**.

Q3 Drag the input marker. What does the x-coordinate of the new point correspond to on the dynagraph? What does the y-coordinate correspond to?

7. Deselect all objects by clicking in blank space. Select the new point and choose **Display | Trace Intersection**. Now drag or animate the input marker and watch as P traces out the graph of $f(x)$.

Q4 Describe the shape of the graph traced by the intersection point. Why does this shape make sense given the behavior of the dynagraph?

SIMULTANEOUS REPRESENTATION

8. Go to page 3 of **Dyna To Cartesian.gsp.**

You'll see a dynagraph and a Cartesian graph, both modeling $f(x) = 2x - 1$. Drag the input marker on the dynagraph and watch both models change simultaneously.

Q5 A classmate says, "One Cartesian point contains the same information as two dynagraph points." Explain what she means.

Double-click the function equation $f(x) = 2x - 1$ to edit it.

9. Explore each of the following functions on the combined dynagraph/Cartesian graph. Enter the function, and then drag the input marker slowly from left to right. Observe what happens to the point on the Cartesian graph as you drag.

$$f(x) = 3 \qquad f(x) = x \qquad f(x) = -x$$
$$f(x) = x^2 \qquad f(x) = -x^2 \qquad f(x) = 5x$$

Q6 Fill in the blanks.

When the input and output markers both move right, the Cartesian point moves ______________.

When the input marker moves right and the output marker moves left, the Cartesian point moves ______________.

Q7 How does the Cartesian graph of $f(x) = 5x$ compare to that of $f(x) = x$? How does this relate to the difference between their dynagraphs?

Q8 Compare dynagraphs and Cartesian graphs. In what ways do you think dynagraphs are better for representing functions? In what ways do you think Cartesian graphs are better?