

Patterns Screen

In the Patterns screen, students explore a variety of functions, make predictions, compose functions, and define a function.

DRAG inputs through the function builder

SEE INSIDE the function; **DRAG** a card past each function and watch it transform

COMPOSE more than one function

DRAG outputs backward through the function. If a function is non-invertible, get feedback:

Function Builder

Number Screen

In the Numbers screen, students can interpret arithmetic functions and compare multiple representations.

VIEW your input/output pairs in a table

Input	Output
-1	$\frac{1}{2}$
0	1
1	$\frac{3}{2}$

BUILD your function with inputs ranging from [-4,7]

VIEW your function as an equation

SHOW all operations or simplify

Function Builder

Equations Screen

In the Equations screen, students can build, interpret, compare, and translate between multiple representations of an algebraic function.

VIEW your input/output pairs in a table

x	y
1	1
4	$\frac{11}{2}$
5	7

VIEW your input/output pairs in a graph

DRAG x to see all possible points on the graph

CHANGE your function at any time

VIEW your function as an equation

$y = \frac{3x - 1}{2}$

Function Builder

Complex Controls

- The carousel contains inputs ranging from $[-4, 6]$ and x .
- Slope-intercept form is always shown on the x card as it advances through the function and when it is in the output carousel.

Mystery Screen

In the Mystery screen, students can play detective to determine the hidden functions.

REVEAL the mystery functions after creating at least three input/output pairs

x	y
0	$-\frac{3}{2}$
1	-1
2	$-\frac{1}{2}$

SEE INSIDE the function after creating at least two input/output pairs

REFRESH to get a random challenge

RESET to get the original three challenges

Function Builder

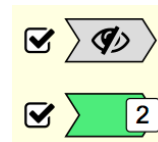
Insights into Student Use

- Students really enjoy composing multiple functions on the Patterns screen. If you have an objective around defining what a function is, you may want to use the single function scene.
- If your students have already learned about graphing linear functions, they may want to explicitly see the slope and y-intercept on the graph. In this sim, the graph is intended to be a more qualitative representation to complement the table and equation.
- Students can use the Equations screen to help them with the Mystery screen. They can build a function and test/modify it until they think it matches the mystery function before revealing the mystery function.



Suggestions for Use

- Explore geometric transformations on the Patterns screen. Determine which functions are dilations, rotations, reflections, translations, or a combination. Determine which functions are not geometric.
- Check both “hide functions” and “see inside.” Advance a card through the builder and determine which functions are in the builder.



Sample Challenge Prompts

- Choose a function for your function machine. After you drag cards through the function, discuss with your partner what you think a function is.
- Which function on the Patterns screen appears to “do nothing”? Which arithmetic functions also “do nothing”?
- Why can you drag a card backward through some functions and not others? Make up your own function that has the same quality and explain why you could not drag a card backward through it.
- Using two functions in your function machine, find an example of when the order in which you place them matters. Describe your findings. Find a different example of when the order does not matter. Summarize when the order does and does not matter.
- Create a function whose outputs appear unchanged when compared to the inputs.
- On the Equations screen, build a function and write it down. Check “see inside” and drag an output card backward through the function until it becomes the original input. Write a function that will “undo” all of your output cards, then test it out.

See all published activities for Function Builder [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).