



## How Are We Related?

► **Materials:**

- Game cards
- Envelopes
- Paper
- Pencil
- Score chart (for the teacher)

► **Directions:**

Students play in teams of three. Each team begins with one envelope, labeled A–N. The envelope contains an original function  $f$ , three transformations, and a transformed function  $g$ . Students work at their seats to order the cards in a way that transforms  $f$  into  $g$ . Teams physically present their solution to the teacher by arranging themselves in the correct order. If the order is correct, the team earns three points. If the order is not correct, the team has one chance to fix it to earn one point. The team returns to their seats with a different envelope. The game continues until one team orders all 14 envelopes, or time is called.

► **Who Wins?**

The team with the highest number of points wins.

► **Tips:**

- There are extra envelopes in case teams finish quickly or must wait to present their solutions.
- Teachers should prepare the envelopes and possible solutions ahead of time. Some envelopes have more than one correct solution.

► **Discuss:**

Discuss whether the order of the transformations matters. When does order matter? When does order not matter?

Game cards for How Are We Related?

**A**

$$f(x) = 5x + 4$$

**B**

$$f(x) = \frac{1}{4}x - 10$$

**A**

vertical stretch by  
a factor of 3

**B**

vertical translation  
6 units up

**A**

horizontal translation  
5 units right

**B**

reflection in the  $y$ -axis

**A**

vertical translation  
2 units up

**B**

vertical stretch by  
a factor of 5

**A**

$$g(x) = 15x - 61$$

**B**

$$g(x) = -\frac{5}{4}x - 20$$

**C**

$$f(x) = -3x - 7$$

**D**

$$f(x) = -\frac{1}{4}x + 6$$

**C**

vertical stretch by  
a factor of 4

**D**

reflection in the  $y$ -axis

**C**

horizontal translation  
11 units left

**D**

horizontal translation  
8 units left

**C**

vertical translation  
4 units up

**D**

vertical translation  
of 12 units down

**C**

$$g(x) = -12x - 156$$

**D**

$$g(x) = \frac{1}{4}x - 4$$

**E**

$$f(x) = -6x - 9$$

**F**

$$f(x) = 5x + 12$$

**E**

vertical shrink by a factor of  $\frac{1}{3}$

**F**

horizontal stretch by  
a factor of 10

**E**

reflection in the  $y$ -axis

**F**

horizontal translation  
14 units right

**E**

vertical translation  
5 units up

**F**

vertical translation  
8 units down

**E**

$$g(x) = 2x + 2$$

**F**

$$g(x) = \frac{1}{2}x - 3$$

**G**

$$f(x) = -3x + 11$$

**H**

$$f(x) = x + 3$$

**G**

vertical translation  
8 units down

**H**

vertical shrink by a factor of  $\frac{1}{3}$

**G**

reflection in the x-axis

**H**

horizontal translation  
6 units right

**G**

horizontal translation  
10 units right

**H**

vertical translation  
5 units down

**G**

$$g(x) = 3x - 33$$

**H**

$$g(x) = \frac{1}{3}x - 6$$

I

$$f(x) = x + 1$$

J

$$f(x) = 9x + 11$$

I

reflection in the  $x$ -axis

J

vertical translation  
1 unit down

I

vertical stretch by  
a factor of 3

J

horizontal translation  
7 units right

I

horizontal translation  
2 units left

J

horizontal shrink  
by a factor of  $\frac{1}{3}$

I

$$g(x) = -3x - 9$$

J

$$g(x) = 27x - 53$$

**K**

$$f(x) = x - 13$$

**L**

$$f(x) = -10x + 4$$

**K**

reflection in the  $y$ -axis

**L**

vertical shrink by a factor of  $\frac{1}{2}$

**K**

vertical translation  
8 units up

**L**

horizontal translation  
6 units left

**K**

horizontal translation  
1 unit left

**L**

vertical translation  
1 unit up

**K**

$$g(x) = -x - 6$$

**L**

$$g(x) = -5x - 27$$

**M**

$$f(x) = 12x + 1$$

**N**

$$f(x) = -16x + 12$$

**M**

horizontal translation  
3 units left

**N**

vertical shrink by a factor of  $\frac{1}{4}$

**M**

vertical translation  
7 units up

**N**

vertical translation  
10 units down

**M**

vertical shrink by a factor of  $\frac{1}{4}$

**N**

reflection in the  $y$ -axis

**M**

$$g(x) = 3x + 11$$

**N**

$$g(x) = 4x - 7$$



Score chart for How Are We Related?

Group 1	Group 2	Group 3	Group 4	Group 5
Group 6	Group 7	Group 8	Group 9	Group 10