LESSON MAKER PRO

Functions in Motion

Build a new function by putting one function inside another.

HIGH SCHOOL · F.BF.A.1.c

F.BF.A.1.c "Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time..."

NAME _____ DATE _____

INSIDE, THEN OUTSIDE

In f(g(x)), the output of g becomes the input of f. Find g(x) first, substitute that whole expression for x in f(x), then simplify.

WORKED EXAMPLE

Let f(x) = 8x + 7 and g(x) = x - 9. Find f(g(x)).

1. Start with the inside function: g(x) = x - 9.
2. Substitute x - 9 into f: f(g(x)) = 8(x - 9) + 7.
3. Simplify: 8x - 72 + 7 = 8x - 65.

Answer: f(g(x)) = 8x - 65

PRACTICE 6 problems

1 Let f(x) = 2x + 1 and g(x) = x + 6. Find f(g(x)).

ANSWER _____

2 Let f(x) = x^2 - 2 and g(x) = x + 1. Find f(g(x)).

ANSWER _____

3 Let f(x) = 3x - 6 and g(x) = 2x + 1. Find g(f(x)).

ANSWER _____

4 Let f(x) = x^2 + 1 and g(x) = x - 2. Find f(g(6)).

ANSWER _____

5 Let f(x) = 6x and g(x) = x^2 + 2. Find both f(g(x)) and g(f(x)).

ANSWER _____

6 Use the table to find f(g(2)) and g(f(1)).

FUNCTION VALUES

x	f(x)	g(x)
0	0	1
1	2	6
2	6	3
3	10	0
6	12	2

ANSWER _____

APPLY IT Show your work

1 A music app charges $6 per month plus $2 per song download. Let C(d) = 2d + 6 be the monthly cost in dollars for d downloads. During one month, you download d(w) = 3w songs in w weeks. Write C(d(w)) and find the cost after 2 weeks.

WORK SPACE

ANSWER _____

2 A phone battery starts at 100%. Playing a game uses 6 percentage points of battery per hour, so B(h) = 100 - 6h gives the battery percentage after h hours. Each round lasts 2 hours, so h(r) = 2r for r rounds. Write B(h(r)) and find the battery percentage after 3 rounds.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Let f(x) = 2x + 1 and g(x) = kx + 2. Find the value of k that makes f(g(x)) = g(f(x)) for every x. Show both compositions to explain your answer.

WORK SPACE AND ANSWER

ANSWER KEY

Functions in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let f(x) = 2x + 1 and g(x) = x + 6. Find f(g(x)).	**2x + 13**
2	Let f(x) = x^2 - 2 and g(x) = x + 1. Find f(g(x)).	**x^2 + 2x - 1**
3	Let f(x) = 3x - 6 and g(x) = 2x + 1. Find g(f(x)).	**6x - 11**
4	Let f(x) = x^2 + 1 and g(x) = x - 2. Find f(g(6)).	**17**
5	Let f(x) = 6x and g(x) = x^2 + 2. Find both f(g(x)) and g(f(x)).	**f(g(x)) = $6x^2$ + 12; g(f(x)) = $36x^2$ + 2**
6	Use the table to find f(g(2)) and g(f(1)).	**f(g(2)) = 10; g(f(1)) = 3**

PART 2 · APPLY IT

1. **C(d(w)) = 6w + 6; after 2 weeks, the cost is $18.** Substitute 3w for d in C(d) to get 2(3w) + 6 = 6w + 6. Then substitute w = 2 to get 18.
2. **B(h(r)) = 100 - 12r; after 3 rounds, the battery is at 64%.** Substitute 2r for h to get 100 - 6(2r) = 100 - 12r. At r = 3, the result is 64.

CHALLENGE

f(g(x)) = 2kx + 5 and g(f(x)) = 2kx + k + 2. Their constant terms must match, so 5 = k + 2 and k = 3.

Accept equivalent expressions, including unsimplified compositions that are mathematically correct. In Problem 5, students must give both compositions in the requested order.