



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Student Exploration: Function Machines 3

**Vocabulary:** function, input, inverse operation, output**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

The city of Metropolis has two taxicab companies: Acme Cabs and Beta Transport. Their prices for different trips are shown in the table below.

1. Based on the table, how do Acme Cabs determine their price? \_\_\_\_\_
- \_\_\_\_\_

Destination	Acme	Beta
Museum (3 miles)	\$9.00	\$14.00
Stadium (4 miles)	\$12.00	\$15.00
Airport (7 miles)	\$21.00	\$18.00

2. How does Beta Transport determine their price? \_\_\_\_\_

3. Ann wants to go to the aquarium 6 miles away. Which company should she use? \_\_\_\_\_

Explain. \_\_\_\_\_

### Gizmo Warm-up

The *Function Machines 3* activity is a follow-up to the *Function Machines 1 and 2* activities. (If you haven't tried those yet, you may want to start with them.) To begin, drag machine **D** onto the left stand, and machines **A** and **B** onto the right stand, stacked as shown in the picture to the right.



1. Click the numbers to run them through the machines.

For each **input** number that goes into the machine, record the **output** number that falls out of the machine.

Machine D	
Input	Output
1	
2	
3	
4	

Machines A and B	
Input	Output
1	
2	
3	
4	

2. What is the **function** for machine **D**? (What does it do to each input?) \_\_\_\_\_

What is the function for the combination of machines **A** and **B**? \_\_\_\_\_

Which machine(s) represents Acme Cabs? \_\_\_\_\_ Beta Transport? \_\_\_\_\_



<b>Activity A:</b>	<u>Get the Gizmo ready:</u>	
<b>Which cab is cheapest?</b>	<ul style="list-style-type: none"> <li>• Click <b>Clear stands</b>.</li> <li>• Turn on <b>Extend legs</b>.</li> </ul>	

A new cab company has opened in town! Champion Taxi charges \$2 per mile, plus a flat \$5 fee.

1. You can model Champion Taxi's pricing plan with two function machines. (The input will be miles.) Drag a blank machine down onto the **FMP 500** (Function Machine Programmer 500).

A. What operation do you need to calculate \$2 per mile? Circle one:    +    -    ×    ÷

B. Program the machine to model the \$2 per mile. What is the function? \_\_\_\_\_

Be sure **Show function** is on, and drag the machine to the blue stand on the left.

C. What operation do you need to add \$5 to the cost? Circle one:    +    -    ×    ÷

D. Program a second machine to add in the \$5 fee. What is the function? \_\_\_\_\_

Be sure **Show function** is on, and drag the machine to the left stand, *below* the first. (The order is important! The \$5 fee needs to be added *after* multiplying by 2.)

2. To find the price of a ride in a Champion Taxi, input the distance of the trip, in miles. The output is the price of the trip. Fill in the table at right using your function machines.

A. What pattern do you notice in the price? (Hint: How much does the price rise for each mile you travel?)

\_\_\_\_\_

B. Based on the pattern, what will be the cost of a 15-mile trip in a Champion Taxi? \_\_\_\_\_

<b>Champion Taxi</b>	
<b>Distance (miles)</b>	<b>Price (dollars)</b>
1	
2	
3	
4	
5	

3. Acme Cabs (machine **D**) charges \$3 per mile. Beta Transport (combination of machines **A** and **B**) charges the distance (\$1 per mile) plus \$11.

For each destination below, calculate the cost with each company. Then circle the cheapest company for that trip. Check answers to A – C using the Gizmo.

A. Hospital (3 miles)                      Acme \_\_\_\_\_                      Beta \_\_\_\_\_                      Champion \_\_\_\_\_

B. Beach (7 miles)                              Acme \_\_\_\_\_                      Beta \_\_\_\_\_                      Champion \_\_\_\_\_

C. Amusement park (9 miles)              Acme \_\_\_\_\_                      Beta \_\_\_\_\_                      Champion \_\_\_\_\_

D. Movie theater (5.5 miles)                Acme \_\_\_\_\_                      Beta \_\_\_\_\_                      Champion \_\_\_\_\_



<b>Activity B:</b> <b>How far did you go?</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>Click <b>Clear stands</b>.</li> </ul>	
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Pierre, the concierge at the Walcott Hotel, wants to make a list of local attractions. To find the distance of each spot from the hotel, he decides to ride a cab and see how much it costs.

- Pierre takes a Beta taxi to the MacIntosh Theater. The trip costs 15 dollars. To model the price of a Beta taxi, program a machine for + 11 and place it on the left stand.

Which input number gives an output of 15? \_\_\_\_\_ How far did Pierre ride? \_\_\_\_\_

- Now program a machine that does the *opposite* of the + 11 machine. In this machine, you can input the money you paid, and the output will be the distance you rode in a Beta taxi.
  - What operation did you use? \_\_\_\_\_ This is the **inverse operation** of addition.
  - What is the function? \_\_\_\_\_
  - Use your new function machine to find how far away these locations are. (Note: To input a number greater than 10, use the up arrow (▲) just to the right of the cards.)  
 Stadium (\$13) \_\_\_\_\_ Park (\$16) \_\_\_\_\_ Library (\$21) \_\_\_\_\_
- Now program an inverse machine for Acme Cabs. (Hint: Acme charges distance  $\times$  3.)
  - What operation did you use? \_\_\_\_\_ This is the inverse of multiplication.
  - What is the function? \_\_\_\_\_
  - Use your new function machine to find the distance to these locations:  
 Zoo (\$15) \_\_\_\_\_ Mall (\$6) \_\_\_\_\_ Golf course (\$33) \_\_\_\_\_
- Program two machines to calculate the distance given the price for a ride on a Champion Taxi. (Hint: Champion charges distance  $\times$  2, and then adds \$5.) Stack the two machines.
  - What is the function of the top machine? \_\_\_\_\_ Bottom machine? \_\_\_\_\_
  - Use your function machines to find the distance of the following locations:  
 Pool (\$19) \_\_\_\_\_ Theater (\$7) \_\_\_\_\_ Pizza place (\$43) \_\_\_\_\_
- Does the order of the two machines matter? \_\_\_\_\_ Explain. \_\_\_\_\_



<b>Activity C:</b> <b>Problem-solving practice</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>Click <b>Clear stands</b>.</li> </ul>	
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You can use the function machines to model all kinds of real-world problems. Program function machines and solve each of the problems below.

1. Max has a bag of M&Ms™. He takes 10 M&Ms and then splits the rest evenly for 6 friends. How many does each friend get? Model this with 2 machines. (Input is M&Ms in the bag.)

- A. What two functions model this problem? \_\_\_\_\_ and \_\_\_\_\_
- B. What is the order of machines? Top: \_\_\_\_\_ Bottom: \_\_\_\_\_
- C. For each number of M&Ms that Frank starts with, state how many each friend gets.  
 88 M&Ms: Each friend gets \_\_\_\_\_      46 M&Ms: Each friend gets \_\_\_\_\_

2. Martina drives a taxicab for Acme Cabs. Every hour, she makes \$15. But she also has to pay a maintenance fee of \$20 every day she drives the cab.

- A. What two functions represent this problem? \_\_\_\_\_ and \_\_\_\_\_
- B. What is the order of machines? Top: \_\_\_\_\_ Bottom: \_\_\_\_\_
- C. How much does Martina earn if she drives for 6 hours? \_\_\_\_\_ 8 hours? \_\_\_\_\_
- D. In this problem, does the order of machines matter? \_\_\_\_\_ Explain. \_\_\_\_\_

\_\_\_\_\_

3. Horizon Phone Company has a plan that costs \$30 per month, plus \$2 per minute. Vertex Communications offers a plan that costs \$10 per month, plus \$3 per minute. Program two machines to represent each plan.

- A. What two functions represent the Horizon plan? \_\_\_\_\_ and \_\_\_\_\_
- B. What two functions represent the Vertex plan? \_\_\_\_\_ and \_\_\_\_\_
- C. How much will the Horizon plan cost if you use 25 minutes in a month? \_\_\_\_\_
- D. How much will the Vertex plan cost if you use 25 minutes in a month? \_\_\_\_\_
- E. To model the pricing plans, why is it important to put the machines in the right order?

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