

Work in pairs, with one person using the mouse and the other person taking notes on this worksheet. Switch roles frequently as you construct, investigate, and respond.

## 1. Warm-Up

**P1** What did you notice, and what did you wonder?

**P2** Is page 2 easier or harder? What makes it different?

**P3** Is page 3 easier or harder than page 1? What makes it different?

## 2. Reflect Dance 1

### *Physical Dance*

Draw a diagram to show the path that each of you followed.

Describe the relative directions you moved in each part of the dance.

When did you both move in the same direction? When did you move in opposite directions?

### **Virtual Dance**

**P1** What do you notice about the relative directions of the dancers?

What do you notice about the relative speeds of the dancers?

Can you find any fixed points? If so, where are they?

**P2** What do you notice about the shape of the *domain* and the shape of the *range*?

**P3** When the penguin moves east (E), which way does the frog move? Why?

When the penguin moves south (S), which way does the frog move? Why?

Try the Plot tool. What does the **Plot** tool do?

What does the **Dance** tool do?

## 3. Construct Reflect Functions

**P1** Drag  $x$  around. What three objects did you use to create this function?

Drag  $x$  again. What do you notice about the relative speed and direction of  $x$  and  $r_m(x)$ ?

Draw a picture of your traces. Show the mirror in your drawing.

**P2** Draw a picture of your traces. Include the labels of the variables and the mirror.

**P3** List other letters you could trace using a reflect function, showing the mirrors.

Draw a picture of the dance. In your picture, show the two variables, the domain, and the mirror.

**P4** What do you notice about these fixed points? What do you wonder?

What do you think the symbols  $r_j(x)$  represent?

If you saw a dependent variable labeled  $r_p(z)$ , what do you think this label would mean?

**P5 Challenge 1:** Can you think of two different ways to construct the two reflections? Describe them.

Make a drawing of your result. Include the labels for the mirrors and variables.

**P6 Challenge 2:** Describe in words what these two labels mean:

$r_j(r_k(x))$ :

$r_k(r_j(x))$ :

How can you arrange  $j$  and  $k$  so that  $r_j(r_k(x))$  and  $r_k(r_j(x))$  lie on top of each other?

Make a drawing of your result. Include labels.

**P7 Challenge 3:** How did you make  $r_k(r_j(x))$  always lie on top of  $x$ ? Draw your result.

## 4. Find the Rule

**P1** What did you notice, and wonder, as you solved these problems?

**P2** Make a drawing of your solution to a particularly interesting challenge. Show the traces, both variables, and the mirror line.

**P3** Make a drawing of your solution to one of the hardest challenge you saw.

What made this challenge harder than others?

**P4** How can this tool help you find the rule?

What else do you notice about this tool? What do you wonder?

## 5. Interlude

How does this video relate to the reflect dance you did earlier?

## 6. Reflect Arcade

**P1** Given independent variable  $x$  and mirror  $j$ , describe how to find  $r_j(x)$ .

What was the highest level at which you scored 8 hits in ten tries?

What methods did you invent to help you improve your score?

**P2** Given mirror  $j$  and  $r_j(x)$ , describe how to find independent variable  $x$ .

What was the highest level at which you scored 8 hits in ten tries?

What methods did you invent to help you improve your score?

**P3** Given independent variable  $x$  and  $r_j(x)$ , describe how to find mirror  $j$ .

What was the highest level at which you scored 8 hits in ten tries?

What methods did you invent to help you improve your score?

**P4** Given independent variable  $x$  and  $r_j(x)$ , describe how to find mirror  $j$ .

How is this way of adjusting the mirror different from page 3?

What was the highest level at which you scored 8 hits in ten tries?

What methods did you invent to help you improve your score?

## Reflect Dance 2

### *On the Floor*

As you created your dance, how did you decide the fourth dancer should move?

In what direction must each of the other dancers move when  $x$  moves:

north?

south?

east?

west?

What else did you notice, and what did you wonder, about the reflect functions that connect your dancers to each other?

How could you use function notation to describe the fourth dancer?

### *On the Screen*

**P1** What do you notice about the speed and direction of the dependent variables when you dragged  $x$ ?

What does the notation  $r_k(r_j(x))$  mean? How does this notation help you explain, in words, how the point behaves?

Help Donte explain why his answer is right.

Help Juanita explain why her answer is right.

**P2** What do you think Juanita and Donte said to each other when they did this construction??

How would you explain to a classmate what is special about perpendicular mirrors?

**P3** What do you notice about the shapes that  $r_j(r_k(x))$  and  $r_k(r_j(x))$  trace?

What do you notice about the locations of  $x$ ,  $r_j(r_k(x))$ , and  $r_k(r_j(x))$ ?

How does changing the distance between the mirrors affect the relative locations of  $x$  and  $r_j(r_k(x))$ ?

How does changing the mirror angle affect the relative locations of  $x$  and  $r_j(r_k(x))$ ?

**P4** Draw a picture of the dance you choreographed. Label the mirrors and the variables in your drawing.

**P5** Draw a picture of the dance you choreographed. Label the mirrors and the variables in your drawing.

## 8. Dependent Dance Challenge

**P1** What do you notice about the speed and direction of the dependent variables when you dragged  $x$ ?

**P1** What did you notice, and wonder, as you practiced the dance on page 1? Did you get better as you practiced? Could you do the dance at a more difficult level and still keep the colors green?

**P2** Is the dance on pages 2 easier (because of your practice on page 1) or harder? Explain.

Having done physical dances and virtual dances, is it easier being the independent variable or the dependent variable? Why?

## 9. Accomplishments

1. What did you observe and learn about how the Reflect function family behaves?
2. Specifically, what did you learn about how  $r(x)$  moves relative to  $x$ ?
3. Describe one or two new skills you developed.
4. List one or two new terms you learned, and explain the term(s) in your own words.
5. Describe one or two things you learned about double reflections (using two mirrors).
6. Which was your favorite activity of the lesson? Why?
7. What was your least favorite activity of the lesson? Why?
8. Describe an example of a reflect function, not already mentioned in this lesson, that you can observe in your school or in your neighborhood.