



## Grade 3 Array Exploration with Scratch - Teacher version

**Mathematics topic:** Solving whole-number multiplication problems with arrays

**Mathematics focus standard:** 3.OA.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

**Focus CT ideas:** Abstraction, Patterns

**Technology tool:** Scratch, project link: <https://scratch.mit.edu/projects/391718710/>

### Student pages

#### **Activity directions:**

1. Share your screen showing the Multiplication Array project at <https://scratch.mit.edu/projects/391718710/>
2. Click the green flag. An *array* of apples will appear. Ask:
  - a. How many apples are in each row of the array?
  - b. How many are in each column?
  - c. How many are there in all?
  - d. What multiplication number sentence could you write to represent the array?
3. Click “See inside” and tell students to look at the code for the project. Ask:
  - a. What numbers do you see in the code?
  - b. How do those numbers relate to what you see in the array?
4. Change the 4 in the code to a 5. Press the green flag and encourage students to watch what happens. Ask:
  - a. What changed?
  - b. How many rows, columns, and apples appear now?
5. Change the 2 to a different number, but don’t run the code yet. Ask students to predict what will happen. Then press the green flag again and allow students to check their predictions.
6. Ask a volunteer to explain how the code works. Encourage them to describe the patterns they notice in their explanations. Their observations might include:
  - a. The numbers in the code control how many rows and columns appear.
  - b. One of the numbers tells the computer how many apples to put in each row.




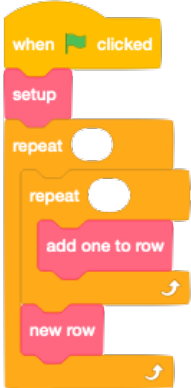
- c. The other number tells the computer how many rows to create.
7. Point out that even though the arrays you made are different sizes, it always just takes two numbers to tell the computer how to create each array. The numbers can be used as an *abstraction* for the array, or a representation that shows just the most important information about it.
8. Ask: Does the code tell you how many apples will be in the array? Ask students to share their ideas about this. Lead a discussion about how the code does not directly show the total number of apples, but students can use multiplication to predict how many apples there will be.
  - a. Explain that before students run the code, they could write a multiplication number sentence with a question mark to represent what they know. For example, if 4 and 2 are in the code, they could write  $2 \times 4 = ?$
9. Introduce the [student pages](#). Explain that students should use the Scratch project to help them complete the table. Go through a few examples of how to work from one representation to complete the others, as needed.



## Array Exploration Student Page

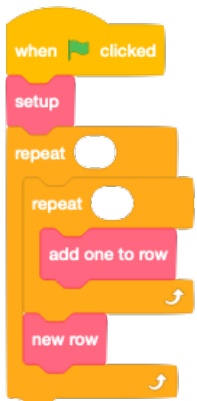
Open the project at <https://scratch.mit.edu/projects/391718710/>

Use the project to fill in the blanks in each row of the table.

Number Sentence	Code	Array	Number of Apples
Example:  $2 \times 4 = ?$	 The code block starts with a yellow "when clicked" block, followed by a pink "setup" block. Then there is an orange "repeat" block with the number 4. Inside this loop is another orange "repeat" block with the number 2. Inside the inner loop is a pink "add one to row" block. After the inner loop, there is a pink "new row" block. The entire code block is enclosed in a larger orange loop with a return arrow at the bottom right.	$\begin{matrix} X & X \\ X & X \\ X & X \\ X & X \end{matrix}$	8
$3 \times 5 = ?$	 The code block starts with a yellow "when clicked" block, followed by a pink "setup" block. Then there is an orange "repeat" block with a blank circle. Inside this loop is another orange "repeat" block with a blank circle. Inside the inner loop is a pink "add one to row" block. After the inner loop, there is a pink "new row" block. The entire code block is enclosed in a larger orange loop with a return arrow at the bottom right.		

Number Sentence	Code	Array	Number of Apples
		<pre> X           </pre>	
			24



<p>Make your own:</p>	 A sequence of Scratch code blocks: a yellow "when clicked" block, a pink "setup" block, an orange "repeat" block with a white circle, an orange "repeat" block with a white circle, a pink "add one to row" block, and a pink "new row" block. Each of the two "repeat" blocks and the "add one to row" block has a small white arrow on its right side, indicating they are nested within the "repeat" blocks.		
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## Grade 3 Array Exploration with Scratch - Student version

1. Open this Scratch project: <https://scratch.mit.edu/projects/391718710/>
2. Click the green flag.  
Draw the array that appears.
3. What multiplication number sentence could you write for this array? \_\_\_\_\_
4. Do you see any of the numbers from your number sentence in the code?  
Write what you notice.  
\_\_\_\_\_  
\_\_\_\_\_

In 5 - 7:

- a. Change the code to match what you see in the code picture.
- b. Run the code and draw the array you see.
- c. Write a multiplication number sentence for the array.

5. Code:



Array:

Number Sentence:

6. Code:



Array:

Number Sentence:

7. Code:



Array:

Number Sentence:



## Grade 3 Geometry Exploration with Geogebra - Teacher version

**Mathematics topic:** Attributes of quadrilaterals, using attributes to define categories

**Mathematics standard:** 3.G.1

**Focus CT ideas:** Abstraction

**Technology tool:** Geogebra (free online dynamic geometry system),

<https://www.geogebra.org/?lang=en>

Specific applet: <https://www.geogebra.org/m/h9ztnrbm> (Note that this is a simplified version of the applet explored in the [PD version](#) of this activity)

### **Activity directions:**

1. Share your screen showing the applet at <https://www.geogebra.org/m/h9ztnrbm>
2. Ask children to look at the four shapes on the screen. Ask:
  - a. What do you *notice* or *wonder* about these shapes?
  - b. What is the same about these shapes?
  - c. What are some differences between the shapes?
  - d. What are your ideas about what the words on the screen mean?
3. Explain that these shapes were created with a special kind of computer program so that when you drag the corners, some things about the shape will change while other things stay the same.
  - a. Drag one corner of the rhombus to a different place on the screen. Ask students to share their thoughts about what changed, and what stayed the same.
  - b. Drag a different corner to a new position. Ask again: What changed and what stayed the same?
  - c. Repeat this process a few more times as needed. Then ask: What are the things that have always stayed the same every time I moved a corner?
  - d. Guide a discussion that helps students identify that the shape always had 4 sides and the 4 sides always stayed the same length. Explain that the word *rhombus* is a name for the category of shapes that have four sides of the same length. A rhombus is a special kind of four-sided shape.
4. Tell students that in a few minutes, they will have a chance to drag the corners of the other shapes. Ask them to share some predictions about what might change and what might stay the same based on what they know about the other words on the screen.

Ask:

  - a. Will the number of sides stay the same?
  - b. Will the length of the sides stay the same?



- c. Will the angles stay the same size?
- d. Why do you think so?

If you are interested in discussing CT, you might explain that when students are looking for the attributes that stay the same, they are focusing on important features, which is abstraction.

- 5. Introduce the [student pages](#). Explain that students should use the digital shapes to help them answer the questions.
- 6. If you are able to conduct a follow-up discussion after students have completed the pages, be sure to discuss the idea that rhombuses, squares, and rectangles are all examples of special kinds of quadrilaterals. Ask students to explain how they know this is true.





## Geometry Exploration Student Pages

With your teacher, you used digital shapes to figure out that a rhombus is a shape that always has 4 sides and the 4 sides are the same length. Now you will explore three other shapes.

1. Open the digital shapes: <https://www.geogebra.org/m/h9ztnrbm>

2. Write down two things you notice about the quadrilateral.

\_\_\_\_\_

3. Drag a corner of the quadrilateral. Write down one thing that changed and one thing that stayed the same.

Changed: \_\_\_\_\_

Stayed the same: \_\_\_\_\_

4. Drag a different corner of the quadrilateral. Write down one thing that changed and one thing that stayed the same.

Changed: \_\_\_\_\_

Stayed the same: \_\_\_\_\_

5. What do you think always stays the same about a quadrilateral?  
Complete this sentence: A quadrilateral is a shape that always has

\_\_\_\_\_

\_\_\_\_\_



6. Write down two things you notice about the square.

\_\_\_\_\_

7. Drag a corner of the square. Then drag another corner. Write down one thing that changed when you dragged a corner. Then write down as many things as you can that stayed the same.

Changed: \_\_\_\_\_

Stayed the same: \_\_\_\_\_

\_\_\_\_\_

8. What do you think always stays the same about a square? Complete this sentence: A square is a shape that always has

\_\_\_\_\_

\_\_\_\_\_ .

9. Write down two things you notice about the rectangle.

\_\_\_\_\_

10. Drag a corner of the rectangle. Then drag another corner. Write down one thing that changed when you dragged a corner. Then write down as many things as you can that stayed the same.

Changed: \_\_\_\_\_

Stayed the same: \_\_\_\_\_



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11. What do you think always stays the same about a rectangle?  
Complete this sentence: A rectangle is a shape that always has

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12. Rhombuses, squares, and rectangles are all special kinds of quadrilaterals. All of these shapes always have four sides.

a. Drag the quadrilateral to make it look like a rhombus.  
Draw it below.

b. Drag the quadrilateral to make it look like a square.  
Draw it below.

c. Drag the quadrilateral to make it look like a rectangle.  
Draw it below.



## Grade 3 Geometry Exploration with Geogebra - Student Version

You will explore shapes on the computer. The shapes are stretchy! When you drag their corners, sometimes they will get bigger or change shape.

1. Open the stretchy shapes: <https://www.geogebra.org/m/h9ztnrbm>

2. Find the shape labeled **quadrilateral**.

Draw what the shape looks like.

3. Click and drag a corner of the quadrilateral.

Draw what the quadrilateral looks like now.

4. Drag another corner of the quadrilateral.

Draw what it looks like now.

5. Look at your three drawings.

a. What is always the same about a quadrilateral?

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b. What can change about a quadrilateral?

---

6. Find the **rhombus**. Draw what you see.

7. Drag a corner of the rhombus.

Draw what you see.

8. Drag another corner of the rhombus.

Draw what you see.

9. Look at your drawings of rhombuses.



a. What is always the same about a rhombus?

---

b. What can change about a rhombus?

---

10. Draw three different **squares**.

Drag the corners of the stretchy square to help you.

11. Look at your drawings of squares.

a. What is always the same about a square?

---

b. What can change about a square?

---

12. Draw three different **rectangles**.

Drag the corners of the stretchy rectangle to help you.

13. Look at your drawings of rectangles.

a. What is always the same about a rectangle?

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b. What can change about a rectangle?

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## Grade 4 Area & Perimeter Exploration with Scratch - PD version

**Mathematics topic:** Area and perimeter of rectangles

**Mathematics standard:** 3.MD.7

**Focus CT ideas:** Debugging, Decomposition

**Technology tool:** Scratch, project link: <https://scratch.mit.edu/projects/391750018/>

**How does this activity demonstrate the affordances of computing?** This project allows children to draw rectangles with particular dimensions quickly and accurately, and this efficient precision allows them to try out many rectangles quickly—likely more than they could create by hand in the same amount of time (Moyer-Packenham & Westenskow, 2013). The code they use to draw the rectangle is also written in terms of properties (angle and length measures), which allows them to see the mathematical properties of rectangles more explicitly than if they drew them by hand (Sarama & Clements, 2009).

### References:

- Sarama, J., & Clements, D. H. (2009). “Concrete” computer manipulatives in mathematics education. *Child Development Perspectives*, 3(3), 145–150. <https://doi.org/10.1111/j.1750-8606.2009.00095.x>
- Moyer-Packenham, P. S., & Westenskow, A. (2013). Effects of virtual manipulatives on student achievement and mathematics learning. *International Journal of Virtual and Personal Learning Environments*, 4(3), 35–50. <https://doi.org/10.4018/jvple.2013070103>

### Activity directions:

1. Open the Drawing rectangles Scratch project at <https://scratch.mit.edu/projects/391750018/>
2. Press the green flag. The beetle will draw a rectangle. If each square on the grid is 1 cm long and 1 cm tall, what is the perimeter of the rectangle the beetle drew? What is the area? How do you know?
3. Click See Inside. Look at the code that tells the beetle to draw the rectangle. Try to figure out how the code works. What do you think each block does?
4. Change one of the numbers in the code and press the green flag. What happened? Does the beetle still draw a rectangle? If not, *debug* the code. Make more changes to make sure the beetle still draws a rectangle.



5. Find the area and perimeter of your new rectangle.
6. Look at the numbers in your code. How do they relate to the area and perimeter?
  - a. The area formula for a rectangle is  $Area = length * width$ . Which two numbers in your code could you multiply to get the area? How can you tell these numbers show the length and width?
  - b. The perimeter formula for a rectangle is  $Perimeter = 2 * length + 2 * width$ . Where do you see two lengths and two widths in your code?
7. Here are some challenges to try. If you don't get them right away, keep trying! You can always *debug* your code if it doesn't do what you wanted it to do on the first try.
  - a. Use your project to make at least three rectangles that have the *same area* but *different perimeters*.
  - b. Use your project to make at least rectangles that have the *same perimeter* but *different areas*.
  - c. Make a rectangle with a length of 12 and an area of 60.
    - i. If you get stuck, try *decomposing* this problem into smaller pieces. First, make any rectangle with a length of 12. Then think: What else can I change to make sure the area is 60?
  - d. Make a rectangle with an area of 32 and a length of 4.
    - i. How could you decompose this problem?
  - e. Make a rectangle with a width of 5.5 and an area of 33.
    - i. How could you decompose this problem?



## Grade 4 Area & Perimeter Exploration with Scratch - Teacher version

**Mathematics topic:** Area and perimeter of rectangles

**Mathematics standard:** 4.MD.3

**Focus CT ideas:** Debugging

**Technology tool:** Scratch, project link: <https://scratch.mit.edu/projects/391750018/>

### **Activity directions:**

1. Share your screen showing the Scratch project at <https://scratch.mit.edu/projects/391750018/>
2. Press the green flag. The beetle will draw a rectangle. Tell students that each square on the grid is 1 cm long and 1 cm tall. Ask:
  - a. What is the perimeter of the rectangle the beetle drew? How do you know?
  - b. What is the area of the rectangle the beetle drew? How do you know?
3. Click See Inside. Encourage students to look at the code that tells the beetle to draw the rectangle. Ask students to tell you what they think each block does.
4. Remind students they just determined that the rectangle had an area of 6 square centimeters and a perimeter of 10 centimeters. Ask:
  - a. Do you see those numbers in the code? (No.)
  - b. What do the numbers in the code represent? (The length and width.)
  - c. If we changed those numbers to a new length and width, do you think you could predict what the area and perimeter of the rectangle would be when you run the code? How can you tell?

Guide a discussion about the idea that we can predict the perimeter and area of a rectangle from the length and width because we know the formulas for area and perimeter. Ask volunteers to remind you of the area and perimeter formulas for rectangles.

5. Change the numbers in the code to show a length of 4 and a width of 5.
  - a. Ask volunteers to predict the perimeter and area and explain how they figured it out.
  - b. Run the code and ask children to check their predictions.





6. Tell children you would like to tell the beetle to create a rectangle that has an area of 10 square centimeters. Ask:
  - a. What numbers could I use for the length and width of a rectangle to give it an area of 10 square centimeters? (5 and 2, 10 and 1).
  - b. How can I change the code to show that length and width?Have children share their ideas about how to edit the code, but don't run the edited code. Explain children will now have a chance to try out their edits for themselves.
  
7. Introduce the [student pages](#) and have children use the Scratch project to complete them.



Area and Perimeter Exploration student pages

1. Open the Scratch project at: <https://scratch.mit.edu/projects/391750018/>
2. Click the green flag and watch the beetle draw a rectangle.
3. Click “See Inside”. Use the numbers you see in the code to help you fill in the blanks in these area and perimeter formulas for the rectangle.

Area = \_\_\_\_\_ \* \_\_\_\_\_ = \_\_\_\_\_ square centimeters

Perimeter = 2 \* \_\_\_\_\_ + 2 \* \_\_\_\_\_ = \_\_\_\_\_ centimeters

In 4 and 5:

- Use the code picture to predict what the area and perimeter of the rectangle will be. Use your predictions to fill in the blanks in the number sentences.
- Change the code on the Scratch project to match the picture.
- Run the code to check your predictions. Debug if you need to!

4.	Area = _____*_____ = _____ sq. cm  Perimeter = 2 * ____ + 2 * ____ = _____ cm	5.	Area = _____*_____ = _____ sq. cm  Perimeter = 2 * ____ + 2 * ____ = _____ cm
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6. How could you change the code so the beetle draws a rectangle with an area of 10 square centimeters?

- Fill in the blanks in the code shown here:
- Change the code in the Scratch project to match.
- Run the code. Does the rectangle have an area of 10 square centimeters? If not, debug!
- Write a number sentence for the area of your rectangle.

\_\_\_\_\_

- Write a number sentence for the perimeter of your rectangle.



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7. How could you change the code so the beetle draws a rectangle with a perimeter of 24 centimeters?

a. Fill in the blanks in the code shown here:

b. Change the code in the Scratch project to match.

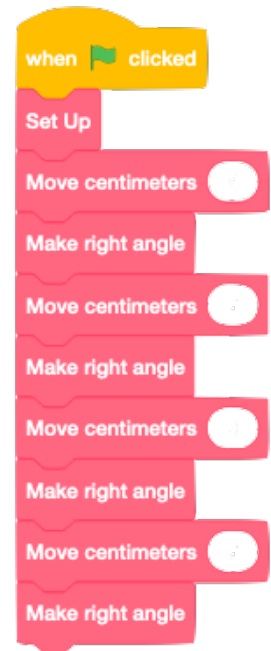
c. Run the code. Does the rectangle have a perimeter of 24 centimeters? If not, debug!

d. Write a number sentence for the area.

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e. Write a number sentence for the perimeter.

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## Grade 4 Area & Perimeter Exploration in Scratch, Student version

These formulas will be helpful as you work on this activity.

**Area formula for a rectangle:**  $\text{Area} = \text{length} * \text{width}$

**Perimeter formula for a rectangle:**  $\text{Perimeter} = 2 * \text{length} + 2 * \text{width}$

1. Open this Scratch project: <https://scratch.mit.edu/projects/391750018/>

2. Press the green flag and watch the beetle draw a rectangle.

a. What is the area of the rectangle you see? \_\_\_\_\_ sq. cm

b. Write a number sentence for the area: \_\_\_\_\_

c. What is the perimeter of the rectangle? \_\_\_\_\_ cm

d. Write a number sentence for the perimeter: \_\_\_\_\_

3. Click “See Inside.” Do you see any of the numbers from your number sentences in the code? Write what you notice.

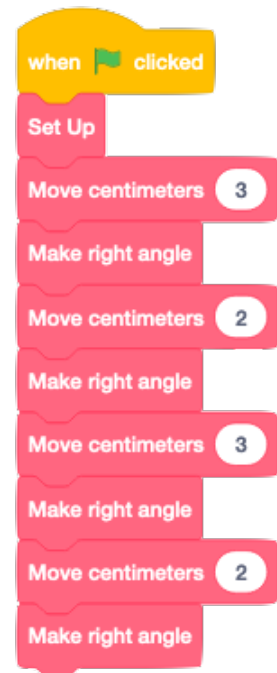
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4. Here is a picture of the code.

Draw an arrow next to each place you see the length of the rectangle.

Draw a star next to each place you see the width of the rectangle.



In 5 and 6:

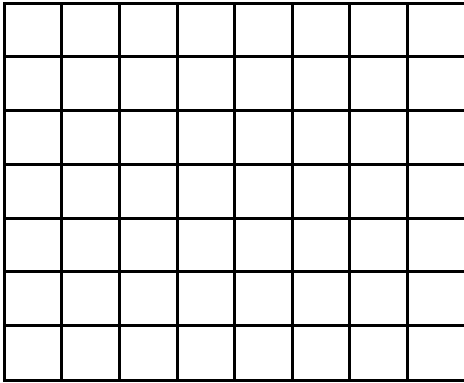


- Fill in the numbers in the code to match the length and width given.
- Change the code in the Scratch projects and run the code.
- Draw the rectangle the beetle draws on the grid.
- Fill in the number sentences for the area and perimeter.

```
when clicked
  Set Up
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
```

```
when clicked
  Set Up
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
  Move centimeters [ ]
  Make right angle
```

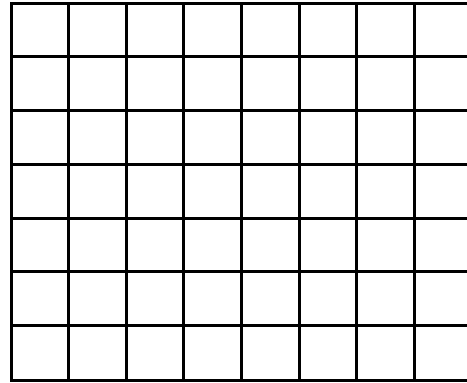
<p>5. Length: 6</p> <p>Width: 5</p> <div style="border: 1px solid black; width: 100%; height: 100%; margin-top: 20px;"></div> <div style="border: 1px solid black; width: 100%; height: 100%; margin-top: 20px; display: flex; justify-content: space-around;"><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div></div>	<p>6. Length: 4</p> <p>Width: 7</p> <div style="border: 1px solid black; width: 100%; height: 100%; margin-top: 20px;"></div> <div style="border: 1px solid black; width: 100%; height: 100%; margin-top: 20px; display: flex; justify-content: space-around;"><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div><div style="border: 1px solid black; width: 20px; height: 20px;"></div></div>
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Area =  $\underline{\quad}$  \*  $\underline{\quad}$  =  $\underline{\quad}$  sq. cm

Perimeter =

$2 * \underline{\quad} + 2 * \underline{\quad} = \underline{\quad}$  cm



Area =  $\underline{\quad}$  \*  $\underline{\quad}$  =  $\underline{\quad}$  sq. cm

Perimeter =

$2 * \underline{\quad} + 2 * \underline{\quad} = \underline{\quad}$  cm



## Grade 4 Equivalent Fraction Exploration with a virtual manipulative - PD version

**Mathematics topic:** Generating and representing equivalent fractions

**Mathematics standard:** 4.NF.1

**Focus CT ideas:** Patterns

**Technology tool:** NCTM Illuminations Equivalent Fractions virtual manipulative, <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>

**How does this activity demonstrate the affordances of computing?** The virtual manipulative has linked representations (Zbiek, Heid, Blume, & Dick, 2007). In this case, the number line automatically updates in response to changes in the area models. The feedback provided by the linked representations offers opportunities for students to meaningfully connect them and understand how they are related. Such automatic linking is not possible without computing.

**Reference:** Zbiek, R. M., Heid, M. K., Blume, G. W., & Dick, T. P. (2007). Research on technology in mathematics education: A perspective of constructs. In F. K. Lester (Ed.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 1169–1207). Charlotte, NC: Information Age Publishing.

### **Activity Directions:**

1. Open the Equivalent Fractions applet at this URL: <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>
2. Look at the red square. What fraction does it show? How do you know?
3. Look at the red fraction on the number line. What do you notice?
4. Drag the horizontal and vertical sliders next to the blue square (at the bottom left) and watch what happens.
  - a. What do you see happening in the square? How does the square relate to each of the numbers on the sliders?
  - b. What do you see happening on the number line? How do the fractions on the number line relate to what's happening in the square?
  - c. How do the fractions on the number line relate to the numbers on the sliders?





5. Choose any positions for the sliders you'd like, except make sure each of them shows at least 2. Then click on the areas inside the square.
  - a. What happens to the areas you click? What happens if you click them twice?
  - b. What happens to the blue fraction on the number line when you click the areas once? Twice?
  - c. How does the numerator of the blue fraction relate to the number of areas you shade?
  - d. How does the *position* of the blue fraction on the number line relate to the number of areas you shade?
6. Look again at the red square and fraction.
  - a. Is the red square more than half full, or less than half full?
  - b. Is the red fraction on the number line closer to 0 or closer to 1?
  - c. Do your answers to a and b make sense? Why or why not?
7. Let's go back to the blue square. Try to make changes so that the blue dot on the number line is at the same spot as the red dot, but the blue fraction and the red fraction have *different denominators*.
8. Now make changes to the green square so that the green dot lines up with the red and blue dots, but all three fractions have different denominators.
9. When you think you have matching fractions, click the check mark. Your fractions should show up in the table. You made *equivalent fractions*. Why do you think they are called equivalent?
10. Press the "New Fraction" button to change the fraction shown in the red square. Make equivalent fractions in the blue and green squares. Add them to the table.
11. Press the "New Fraction" button again and make another set of equivalent fractions.
  - a. *Challenge*: Can you make one of the fractions have a denominator that is *less than* the denominator of the red fraction? Why or why not?
12. Look at the sets of equivalent fractions in your table. What patterns do you notice?
13. Press the "New Fraction" button one more time. Use the patterns you noticed in the table to predict two fractions that are equivalent to the red fraction. Then make those fractions in the blue and red squares to check your prediction.

Throughout this activity, you looked for *patterns*. You used them to understand how the area models, number line, and fraction numerators and denominators were related. You also used



them to make predictions, and used the applet to check your predictions. Computer scientists often look for patterns to understand how things work and to make predictions!



## Grade 4 Equivalent Fraction Exploration with a virtual manipulative - Teacher Version

**Mathematics topic:** Generating and representing equivalent fractions 4.NF.1

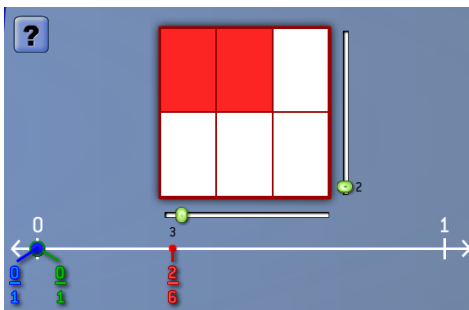
**Mathematics standard:** 4. NF.1

**Focus CT idea:** Patterns

**Technology tool:** NCTM Illuminations Equivalent Fractions virtual manipulative, <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>

### Activity Directions:

1. Open the Equivalent Fractions applet at this URL: <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>
2. Choose "Build Your Own." Then share your screen.
3. Tell students you are going to use the red square to show a fraction. Move the sliders and click some of the sections in the square to represent a fraction without saying aloud the name of the fraction. You can choose a fraction appropriate for the experiences of students in your classroom. These activity directions will use  $\frac{2}{6}$  as the fraction, as shown below.



4. Ask students to tell you what fraction is shown in the red square and how they can tell. (Sample answer: The red square shows  $\frac{2}{6}$  because there are six parts in the square and two are shaded.)
5. Ask: Where else do you see  $\frac{2}{6}$ ? (The red fraction on the number line is  $\frac{2}{6}$ .)
6. Tell students you will make some changes in the red square and they should watch what happens to the red fraction on the number line. Fill in more of the parts in the area model. Then remove some shading in the area model (by clicking a red section again).  
Ask:




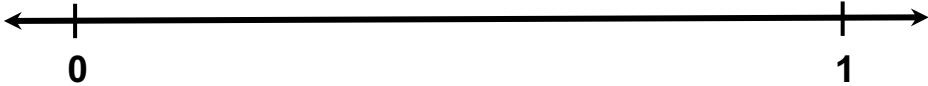

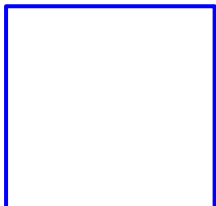




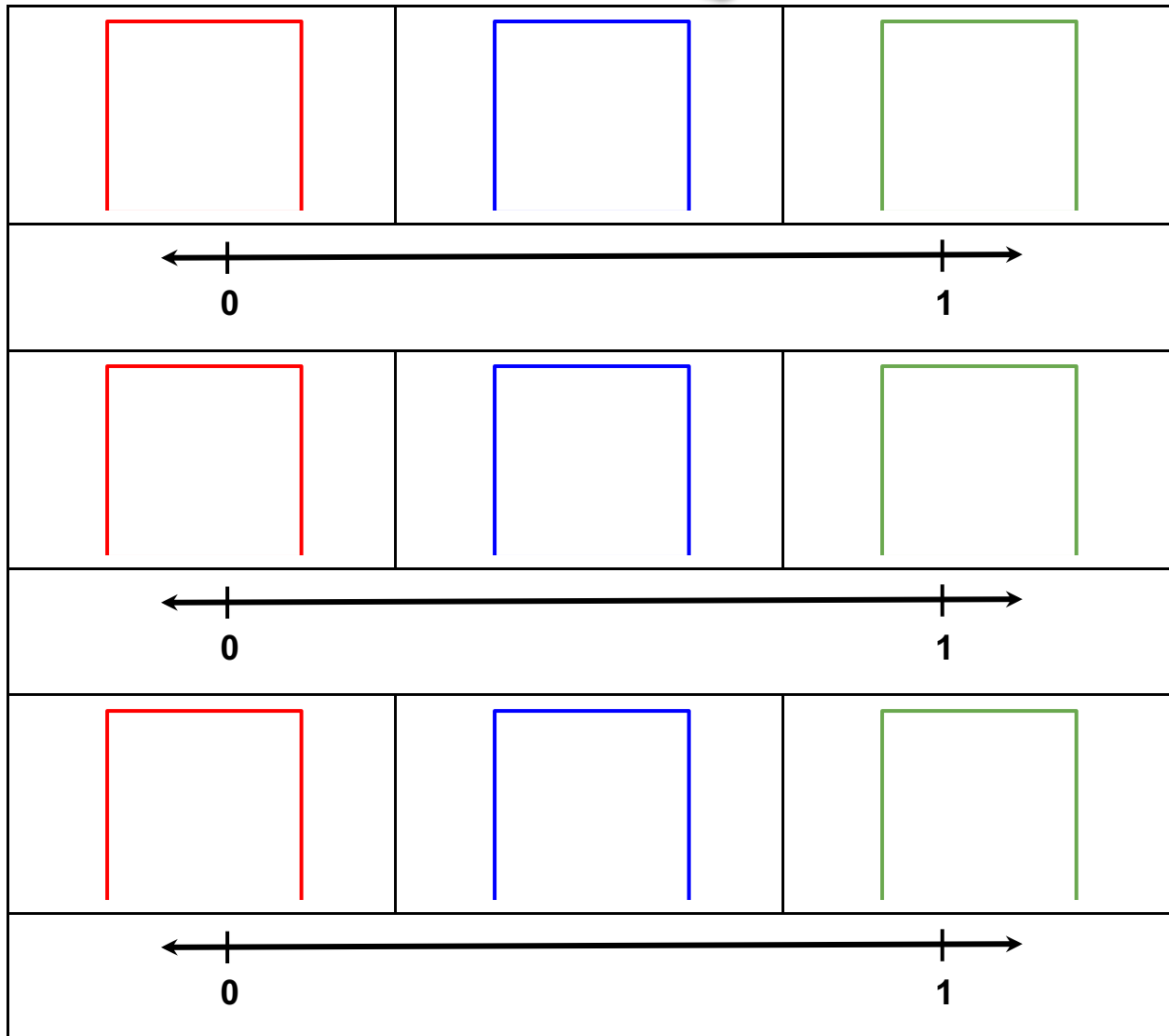
- a. What did you notice? (Sample answers: The numerator changed. The red dot moved toward the 1 when you added shading. The red dot moved toward the 0 when you took away shading.)
  - b. How do you think we could get the denominator of the red fraction to change? (The denominator is the number of parts, so we could change how many parts there are in the red square.)
7. Draw students' attention to the blue and green fractions on the number line. Ask for ideas about how you might be able to get those to change. (Change the parts and shading in the blue and green squares.)
8. Move the sliders on the blue square so that it is divided into 12 parts. Shade in two parts. Ask:
  - a. What fraction does the blue square show? ( $2/12$ )
  - b. Is that greater than or less than  $2/6$ ? How can you tell? Encourage students to think about how you can tell from the area models *and* how you can tell from the number line. (Less than because a smaller part of the blue square is shaded. Less than because the blue dot is closer to 0 on the number line than the red dot.)
  - c. Shade in two more parts to show  $4/12$ . Ask: What fraction does the blue square show now? ( $4/12$ ) Is  $4/12$  greater than or less than  $2/6$ ? How can you tell? (They are equal because the number line dots are at the same spot and the same amount of color is in each square.)
9. Press the check mark button. Point out that the green check mark on the blue square means that the fraction shown in the blue square is equivalent to the fraction shown in the red square. There is a red X on the green square because it doesn't show a fraction equivalent to the other two fractions yet. Ask for suggestions from students about how they could find another equivalent fraction. Sample strategies:
  - a. Divide the green square into two pieces horizontally. Then make the pieces in each half skinnier and skinnier until you find a number where you can shade the same amount as the red and blue squares.
  - b. Look for patterns in the numerator and denominators of the two fractions that are already equivalent. See if you can use the patterns to guess another equivalent fraction, then use the area model and number line to check your prediction.
10. As a class, show another equivalent fraction in the green square. Click the check mark to check your work. Point out how when students find three equivalent fractions, they will show up in the table.
11. Introduce the [student pages](#). Have students use the fraction tool to complete the pages.



## Equivalent Fractions Exploration Student Pages

1. Open this fraction tool: <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>
2. Click the dot next to "Build Your Own."
3. For each row:
  - a. Change the red square to show any fraction you choose.
  - b. Use the blue and green squares to show fractions equal to the fraction shown in the red square. Use the check mark button check your work.
  - c. When you have found three equal fractions, divide and shade the red, blue, and green squares here to show what you did.
  - d. Show the three fractions on the number line.



4. What patterns do you notice in the table of fractions on your screen?

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5. **Challenge:** Click the dot next to “Automatic.” Find fractions equal to the fraction shown in the red square. Record your work on a separate sheet of paper.



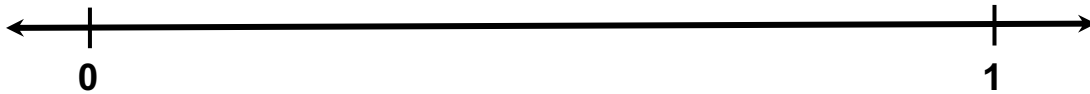
## Grade 4 Equivalent Fraction Exploration with a virtual manipulative - student version

1. Open this fraction tool: <https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Equivalent-Fractions/>

2. Click the dot next to “Build Your Own.”

3. Use the slider below the red square to divide the red square into two parts. Click one of the parts to shade it red. What fraction does the red square show now? \_\_\_\_\_

4. What happened to the red fraction on the number line? Draw it below.



5. Move the sliders by the blue square so that it has 4 parts. Shade in two of the parts. What fraction does the blue square show? \_\_\_\_\_

6. Add the blue fraction to the number line under question 4.

7. What do you notice about the red and blue dots on the number line?  
\_\_\_\_\_

8. When two fractions are equal, they are shown at the same point on the number line and by shading in the same amount of a square.

a. Make changes to the green square so it shows a fraction equal to  $\frac{1}{2}$  and  $\frac{2}{4}$ . Show how you divided and shaded your square.

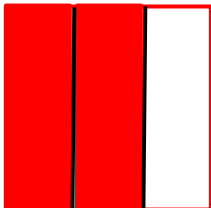
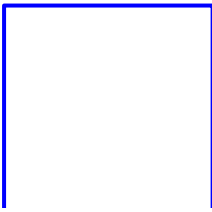

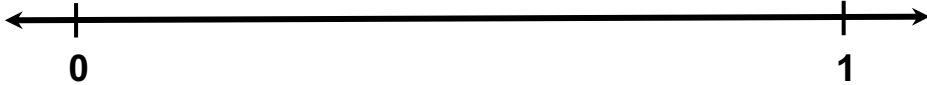
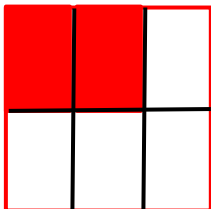
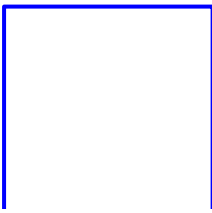

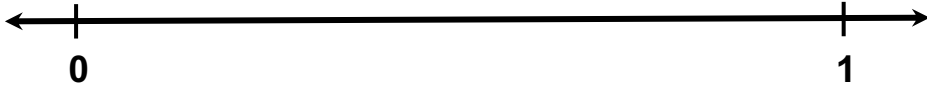
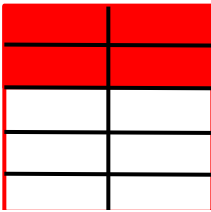
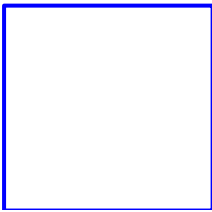

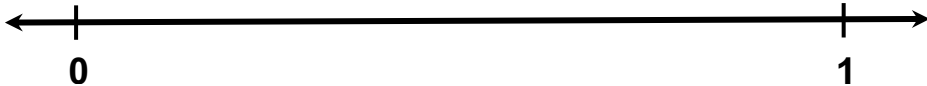


b. Add the fraction to the number line under question 4.

9. Press the check mark button. If you found three equal fractions, they will show up in the table. If you did not, make changes and try again.

10. For each row:

- Change the red square to look like what is shown.
- Use the blue and green squares to show fractions equal to the fraction shown in the red square. Divide and shade the blue and green squares here to show what you did.
- Show the three fractions on the number line.





11. What patterns do you notice in the table of fractions on your screen?

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