Counters

Counting On and Back by 1 and 2
With Counters, you can act out the process of adding 1 or 2 more. You can also act out the process of subtracting 1 or 2.

- Use the container workspace: 🧳.
- Use 🔄 to move counters around the workspace.

Practice Using Counters

1. Above your container, click on 🔄 Show Count. 0 will be visible on your container.
2. Place counters in your container. Place 5 🍎 using 🔄.
   - Click on 🍎. Drag the 🍎 to your 🧳 and release. Notice 0 is now 1 on the container.
   - Continue to click and drag the 🍎 into the bag until the bag displays 🧳.
3. Place 2 🍎 in the workspace, but outside of the 🧳. Click 🔄 to display the Odometer at the bottom, which will show 7.
4. To count on, use 🔄 to move the 🍎 from the workspace into 🧳.
   - Click on one 🍎 and drag it into the bag.
   - Notice the count increases by 1. Repeat with the other 🍎.
5. Click on 🔄 Show Objects. Now the contents of the container show.
6. To count back, use 🔄 to take away one 🍎.
   - Click on 🔄, then click one 🍎 inside the 🧳.
   - Notice that the count decreases by 1 in the Odometer.
Counters

Using Different Workspaces in Counters
Use different workspaces to compare the amount of Counters and see the total.

- Use the 2-part workspace: 🟢.
- Use 🔶 to move counters around the workspace.
- Use 🔷 to copy or “clone” counters.

Practice Using Counters
1. In the 2-part workspace, you will see two additional Odometers at the top of each workspace. Click 🔄 to show 0 on the two Odometers at the top and one Odometer at the bottom of the Tool.
2. Use 🔶 to click and drag 5 ⭐ onto the left workspace. Notice the Odometer will display 5.
3. In the workspace, click and drag a rectangle around 4 of the ⭐. You will see each star highlighted in blue.
4. Now click 🔷 and click on the highlighted ⭐. You will see 4 more stars pop up on screen and the Odometer will display 9.

5. Use 🔶 to click and drag the 4 blue highlighted stars into the right workspace. Notice the Odometers on the top of the Tool will read 5 and 4; the Odometer at the bottom of the Tool still reads 9.
6. Click 🔄 to compare the two workspaces and see which has a greater number.
7. To change the color of the stars in the right workspace, use 🟢🔴.
Counters

Multiplying Whole Numbers

You can use arrays to multiply two whole numbers. To get to the Arrays mode, click to see the drop-down menu and select Arrays.

- Click on and drag to resize the array.

Practice Using Arrays

1 Name your first factor. Use 3. Click on and drag to adjust the number on the vertical axis to 3.
2 Name your second factor. Click on and drag to adjust the number on the horizontal axis to 4.
3 Count the . The total number is the product.
4 Click to see the product, 12, shown in the Odometer. Click again to see the product written as words, and again to see an expression, \(3 \times 4\).

The largest number the array can show is \(10 \times 10\), or 100 .
Counters: Integers

Counting Integers

You can use counters to subtract integers. To get to the Integers mode, click \( \text{Integers} \) to see the drop-down menu and select **Integers**.

- The one-part workspace provides a space to drag both red and yellow counters onto the mat, each representing an integer. The yellow counters are always the minuend or first number in the subtraction sentence. The red counters are always the subtrahend or the second number in the subtraction sentence.

- Drag counters on to the mat. Count them and use the other color counter to show subtraction of integers.

Practice Using Counters

1. Illustrate the subtraction of the integers \( 4 - 3 \).
   - Drag 4 yellow counters onto the mat. Then drag 3 red counters onto the mat. Count the difference.

   \[ 4 - 3 = 1. \] Click \( \text{Reset All} \) to show the equation.

2. To arrange the counters, click \( \text{Reset All} \). This will arrange the counters in a line for easier viewing and counting.

3. Anytime you want to start a new set of counting integers, use \( \text{Reset All} \) to clear the mat and start over.
Counters

Finding the Difference

You can use counters to model subtraction. To get to the Difference mode, click to see the drop-down menu and select Difference.

The Difference mode will always subtract the greater number of counters from the lesser number. For example, if there are more yellow counters, then the Tool will use the yellow counters as the first number in the subtraction sentence or “minuend”. If there are a greater number of red counters, the Tool will use the red counters as the first number in the subtraction sentence. This way, all problems result in a positive number.

- You can place counters on the workspace, then move them into different positions to compare them.
- Use to show the subtraction.

Practice Using Counters to Subtract

1. Model and solve the subtraction problem 5 − 2.
   Drag 5 into the workspace and place in a row, as shown at right. This is the minuend.

2. Drag 2 for the subtrahend into the workspace and place in a row below.
   You can compare the lengths of the lines of counters to find that there are 2 more yellow counters than red counters.

3. Click . The counters will move on top of each other to show the extras, or the difference. You can click it again to undo the action and separate the counters again, to show all of the counters.

4. By looking at the workspace and the Odometer, you can see that 5 − 2 = 3.
Additional Features

- You can use the to copy counters instead of dragging them onto the desktop. This is especially useful with larger numbers.

- You can use the to erase counters on the workspace.

- The Text box and Text box with arrow buttons are along the top of the Tool. When you click on one of the Text box buttons, a dialog box will appear on the workspace. You can add any text into this box. You can also drag the box anywhere on the workspace. When you click outside the box, the outline of the box disappears and only the text and arrow are visible.

- In Counters mode in the Basic Workspace, you can put counters in a ten-frame. Click the ten-frame button and then click on the workspace. Click on and drag counters into the ten-frame.
Data and Graphs

Plot Data
You can format, copy, and sort data that you enter in a table. The data can be used to show differences among graph types.

Practice Plotting Data
1 Enter data that contains percentages to be shown on a circle graph.
2 Change the header labels.
   ● Click on the header labeled “Column A”. In the window, click the ▼ and select “New”. Type the new header, “Siblings” and then click x to save.
   ● Click on the header labeled “Column B”. In the window, click the ▼ and select “New”. Type the new header, “Percent of Class” and then click x to save.
3 Enter data under the “Siblings” column.
   ● Click on the first cell under the header “Siblings” and type “Only child”.
   ● Click on the second cell and type “1 sibling”. Enter “2 siblings” for the third cell and “3 or more” for the fourth.
4 Enter data under the “Percent of Class” column.
   ● Click on the first cell under the header “Percent of Class” and type 25.
   ● Click on the second cell and type 30.
   ● Copy and paste data from the cell above by clicking on that cell and then clicking . Click on the third cell and click . You should see 30 in the third cell.
   ● Click on the fourth cell and type 15.
5 Order the data from lowest percent to highest.
   ● Click on the column header “Percent”. In the window under “Sort Rows”, click Low to High . Click x to save.
6 Choose a circle graph to display the data.
Display a circle graph by clicking the drop down menu on the bottom right and clicking on Circle Graph

In the window, make the circle graph settings as follows:
Creating Plots
You can create a graph or plot when you are working in the Primary workspace.

- To choose a graph type, click [select graph type] and then click the graph/plot of your choice.

Practice Creating Plots:
Bar Graph

1 Add labels along the bottom of the graph.
   - Click on “Label 1” underCogwheel. Delete the text, and enter “dog”.
   - Click + to add a label. Click on “Label 2” and enter “cat”.
   - Follow the same procedure as above to make new labels: “hamster”, “fish”, and “bird”.
     There are now 5 labels for the bar graph.

2 Add vertical bars for each label.
   - Click above “dog” and drag up so that the bar reaches “5”.
   - Click above “cat” and drag up so that the bar reaches “7”.
   - Follow the same procedure as above to add bars for the rest of the labels as follows: hamster = 3, fish = 6, bird = 7.

3 Add a title to the graph.
   - Click on “Editable Graph Title” at the top of the graph.
   - Delete the text and then enter “Types of Pets for Students”.

4 Make adjustments to the graph.
   - Click to the left of the graph, and slide it down so that the number “8” is the top number.
   - To remove a bar from the graph, click and then click the bar above “hamster”.

5 View the data in the table.
• Click . The data you see will be pulled from the bar graph.

**Additional Features:**

The other workspaces in this mode include:
Circle graph, Line Graph, Scatter Plot, Line Plot, Picture Graph

For the Line Plot, you add labels by clicking . You add points by clicking and dragging above the labels.

For the Picture Graph, you can have up to 4 rows with different pictures from the choices provided to represent data. To add a picture to a row, click and drag the picture to the last box that you want it to appear. Click to erase a picture from the graph.
Graph Coordinates and Equations

In the coordinate plane workspace, the x-axis and y-axis intersect at the origin.

Use when you only want to use the first quadrant of the coordinate plane.

Use when you want to use the four quadrant coordinate plane.

Practice Graphing on a Coordinate Plane

2 When you open the Equation Grapher, the line graphed is \( y = x + 0 \). There is no number in front of “x”. The equation can be written as \( y = 1x + 0 \), where 1 is the slope, or steepness of the line. The “0” names the point where the line crosses the y-axis.

2 Change the line so that it crosses the y-axis at a different point.
   - Click and drag the point at the origin up along the y-axis. Stop when 4 is shown in the equation in the bottom left of the screen.
   - The line now crosses the y-axis at 4.

3 Move the point (4,4) so that the line crosses the x-axis at 2.
   - Click and drag the point (4,4) straight down so that the coordinate point shown is (4,–4).
   - The line now crosses the x-axis at 2.

4 Move the line to cross the y-axis at –30.
   - Notice the scale on the y-axis ranges from –10 to 10. Click on the .
   - Click and drag the point down until the line crosses the y-axis at –30.

5 Change the line so that it has a positive slope of 0.5, or \( \frac{1}{2} \).
   - Drag the point (0,30) back up to where the y-coordinate is within –10 and +10.
   - Click on the to zoom back in to the original scale.
   - Click and drag the point on the y-axis to the point (0,–2). Then click and drag the point (4,–4)
up and to the right to (8,2).

- The equation in the bottom-left of the screen reads $y = 0.5x + 2$. The slope is 0.5 and the line crosses the y-axis at -2.

6 Add a coordinate point on the line.

- Click on the in the bottom of the screen.
- Drag the point so that it reads (-4, -4) on the graph.
- The values -4 and -4 are now highlighted in the first row of the table.
Fractions

Fraction Sums and Mixed Numbers
You can add fractions to make mixed numbers.

- You can add fractions that have a denominator of 2, 3, 4, 5, 6, 8, 10, 12, or 16 (strips workspace used below).
- Make sure that the mode displays Pieces in the upper-left shell.
- When an improper fraction is displayed in the Odometer, click to show it as a mixed number.

Practice Using the Pieces Mode in the Strips Workspace

1. Place fraction pieces in the workspace.
   - Click $\frac{1}{2}$, then click $\frac{1}{3}$.
   - Click to show “5/6.” Notice that the MathTool finds the least common denominator and displays the sum in the Odometer.
   - Click $\frac{1}{6}$. Now you have made 6/6, or 1 whole.
   - Click on to switch back and forth between improper fraction and whole-number displays.

2. Continue to add fraction pieces to the workspace.
   - Click $\frac{1}{12}$ three times. Click $\frac{1}{8}$ three times. Click $\frac{1}{5}$ twice.
   - Notice the Odometer. As you go along, click to see improper fraction and mixed-number representations of the pieces.
Modeling Equivalent Fractions
You can find equivalents of fractions less than 1. To get to the Equivalent Shapes mode, click \(\text{Equivalent Shapes}\) to see the drop-down menu and select **Equivalent Shapes**.

- The active workspace is marked by an orange highlight. Actions are applied to this workspace only.
- You can model fractions that have a denominator of 2, 3, 4, 5, 6, 8, 10, 12, or 16 (wedges workspace used below).

Practice Using Equivalent Shapes Mode

1. Model a fraction in the left workspace. Use \(\frac{1}{2}\).
   - Click \(\frac{1}{2}\).

2. Find an equivalent fraction in the right workspace.
   - Click inside the right workspace. Notice the orange box around the active workspace.
   - Think of multiples of 2 to use for a denominator. Use \(\frac{1}{4}\).
   - Click \(\frac{1}{4}\) to place wedges in the circle until \(=\) appears between the two workspaces.

3. Find another fraction equivalent to \(\frac{1}{2}\).
   - Click \(\text{Trash can}\) twice to erase the 2 wedges in the circle.
   - Click \(\frac{1}{6}\) to place wedges in the circle until \(=\) appears between the two workspaces.

4. Find more fractions equivalent to \(\frac{1}{2}\).
   - Repeat Step 3 using \(\frac{1}{8}\), \(\frac{1}{10}\), \(\frac{1}{12}\), and \(\frac{1}{16}\).

Additional Features
You can click \(\text{Show Info}\) to see each part expressed as a fraction, a decimal, words, or a percent.
Constructing Fractions of Shapes

You can break shapes into fractional pieces. To get to the Modeling Fractions mode, click \( \downarrow \) to see the drop-down menu and select **Modeling Fractions**.

- The active shape is marked by \( \square \) in the bottom left corner.
- You can break whole shapes apart to model fractions that have any denominator that evenly divides the shape, up to 12.

**Practice Using Modeling Fractions Mode**

1. Select the shape to model.
   - Click the arrow in \( \square \) and select the \( \square \) from the menu.
   - Click and drag 2 copies of the hexagon into the workspace.
   - Click the right side of \( \square \) and select \( \square \) to change the selected color. Then click on a hexagon to paint it.

2. Break one shape into sixths.
   - Select the \( \square \) and click on one of the hexagons.
   - In the Hammer Options dialog, click \( \leftarrow \rightarrow \) to select 6 parts. Click OK to close the dialog.

3. Break the other shape into thirds.
   - Select the \( \square \) and click on the other hexagon.
   - In the Hammer Options dialog, click \( \leftarrow \rightarrow \) to select 3 parts. Click OK to close the dialog.

4. Drag the hexagon parts around to create new shapes. Compare the sizes of the parts.

5. Select \( \square \) to show the sizes of all pieces.

6. Combine parts to make a whole again.
   - Select two 1/3 parts and two 1/6 parts with the \( \square \), to make 1 whole.
   - Click \( \square \) to combine the parts into a hexagon.
Modeling Fractions Less Than 1
You can model a fraction using the Wedges workspace or the Strips workspace. To get to the Denominators mode, click to see the drop-down menu and select Denominators.

● You can model fractions that have a denominator of 2, 3, 4, 5, 6, 8, 10, 12, or 16.
● Use to shade a wedge or strip and also to clear the shading from a wedge or strip.
● Click on to switch between the Wedges and Strips workspaces.

Practice Using Fraction Wedges
1 Choose a denominator for the fraction that you want to model.
   ● Click in the denominator of the fraction.
   ● Select from the denominator menu.
     Select 6.
   ● Notice the circle is now separated into six equal wedges.
2 Shade wedges to represent the numerator for the fraction that you want to model.
   ● Choose a numerator. Use 5.
   ● Click inside 5 of the 6 wedges to represent the numerator.
   ● Notice the Odometer shows five sixths as “5/6.”
3 Click to see the decimal form of 5/6 inside the Odometer. Click again to see it in word form, again to see it as a percent, and one more time to hide the label entirely.

Practice Using Fraction Strips
4 The process is the same as those used in Steps 1 – 3 when you use the Strips workspace.
   ● The fraction modeled at the right is 7/12.
Building with Fraction Strips

You can combine and compare fractions. To get to the Fraction Strips mode, click \( \text{ } \) to see the drop-down menu and select **Fraction Strips**.

- You can model fractions that have a denominator of 1, 2, 3, 4, 5, 6, 8, 10, or 12.
- You can compare fraction strips to a number line.

Practice Using Fraction Strips Mode

1. **Model the fraction \( \frac{6}{8} \).**

   - In the palette, click on the sixth piece of the blue eighths bar, and drag it into the workspace. A fraction bar of length \( \frac{6}{8} \) is created.

2. **Use fraction strips to find an equivalent fraction with denominator 12.**

   - In the palette, click on the first piece on the black twelths bar, and drag it into the workspace. Line it up below one end of the blue bar.

   - Use the \( \text{ } \) to make copies of the \( \frac{1}{12} \) bar, lining each one up below the blue bar, until the lengths are equal.

3. **Or use the number line to find an equivalent fraction with denominator 12.**

   - Select \( \text{ } \text{ } \) to view a number line in the workspace.

   - Drag the blue fraction bar to the left end of the number line, lining it up with 0.

   - Click the \( \text{ } \text{ } \) buttons to change the denominator modeled by the number line. Select \( \text{ } 12 \).

   - Read the label on the tick mark at the right end of the \( \frac{6}{8} \) fraction bar to find the equivalent fraction.

Additional Features

You can use \( \text{ } \) to find the sum of fraction strips. Click on strips to add their lengths to the sum.
Multiplying Fractions

To get to the Array mode, click to see the drop-down menu and select Array.

- You can multiply two fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 12, or 16.
- When you change the denominators in the fractions, you adjust the number of squares in 1 whole. You can also change the number of whole numbers that the array models.
- The purple shaded rectangle’s width and length correspond to the numerators of the fractions.

Practice Using Arrays

1. Set the size of the array. Use 2.
   - Click the Number of wholes button.
   - Select from the menu .
   - Click on the denominator of the fraction along the vertical scale.
   - Select from the menu to name the denominator.
   - Click and drag to adjust the numerator to 5.
   - Click and notice the first factor, 5/8, is shown as “5/8” in the top Odometer.
3. Name your second factor. Use 21/16.
   - Click in the denominator of the fraction along the horizontal scale.
   - Select 16 from the menu to name the denominator.
   - Click and drag to adjust the numerator to 21.
   - Notice the second factor, 21/16, is shown as “21/16” in the middle Odometer.
4. The product, 105/128, is shown as “105/128” in the bottom Odometer. Click to see the Odometer amounts as decimals, written as words, or as percents.
Modeling on a Number Line

You can model fraction multiplication on a number line. To get to the Multiplying Fractions on a Number Line mode, click to see the drop-down menu and select **Multiplying Fractions on a Number Line**.

- You can model fractions with a denominator of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, or 100.

Practice Multiplying Fractions on a Number Line

1. Model the fraction 4/3 on the number line.
   - Click and select 1/3 from the menu.
   - Drag from the bottom shell onto the number line, with its left point at the 0 tick mark.
   - Drag the arrow portion of the arc to the right, to 4/3. The arc label is now “4/3”.

2. Multiply 4/3 × 6 on the number line.
   - Drag another from the bottom shell onto the number line, with its point at the arrow of the first arc. The new arc resizes to match the first one.
   - Continue until you have 6 copies of the arc. The final arc lands on the product 4/3 × 6.
   - Drag from the bottom shell to the end of the final arc to show the product.

Additional Features

- You can change the endpoints of the number line by dragging the line, by clicking the arrows, or by clicking on an endpoint label and entering an endpoint value using the keyboard or the keypad.
- You can change the range of the number line by clicking the buttons.
Geometry

Shapes
Nine basic geometric shapes are included in the Shapes mode.
● After a shape is placed in the workspace, you can flip or rotate it. You can also change its color and relocate it in the workspace.

Practice Using Geometry Shapes
1 Place a shape in the workspace. Use a square.
   ● Click and hold . Drag the shape onto the workspace.
   ● Move the cursor to the location in the workspace where you want to place the square and release.
2 Place one of all the other shapes in the workspace.
   ● Use the same procedure as you did for Step 1.
3 Classify and organize the shapes. Form groups of triangles, quadrilaterals, and other polygons.
   ● Use to select and reposition the shapes in the workspace.
   ● Move both triangles to a row along the top of the workspace.
   ● Move the quadrilaterals to a row in the middle of the workspace.
   ● Rotate the so that it looks like . To rotate a shape, drag any corner of the shape in a clockwise or counterclockwise direction.
   ● Move the other polygons to a row along the bottom of the workspace.
4 Change the colors of the shapes.
   ● Make all triangles yellow. Make all quadrilaterals green. Make all other polygons orange.
   ● Click and select yellow . Move the cursor over the triangle and click. Its color will change to yellow. Click on the other triangle to change its color.
● Click 🌿 and select green 🟢. Move the cursor over the quadrilateral and click. Its color will change to green. Click on the other quadrilaterals to change their color.

● Click 🍊 and select orange 🟠. Move the cursor over the pentagon and click. Its color will change to orange. Click on the hexagon and octagon to change their color.
Geometry

Tangrams

Five tangram pieces of different colors are included in the Tangrams mode, along with a large square piece that is made from the tangram pieces. To get to the Tangrams mode, click to see the drop-down menu and select Tangrams.

- You can drag the pieces onto the workspace multiple times as long as the new piece dragged does not overlap with an existing piece. Each tangram piece can be flipped.
- The pieces that make up the large square can be taken apart after the square is on the workspace.

Practice Filling an Outline Figure with Tangrams

1. Choose the outline that you want to fill with tangrams.
   - Ten different outlines will appear from which you can choose.
   - Click the button in the bottom left of the screen.
   - Click the and drag it onto the workspace.
   - Since the outline you chose appears to involve triangular tangrams, click on the button to help you choose the right tangram for the outline and for easier placement.

2. Place the first tangram piece to fit in the bottom of the outline, where the bigger tangrams will be placed.
   - Click and drag the onto the workspace.
   - Click the, and then click the tangram to flip it vertically.
   - Click the to activate the pointer again. You can now drag the tangram into the outline.

3. Rotate a tangram to position in the outline.
   - Click and drag another onto the workspace.
● Click on any corner of the triangle and drag it in a clockwise or counter-clockwise direction so that it looks like ![triangle]

● Drag the rotated tangram so that it snaps with the first piece into the bottom of the outline.

4 Flip and rotate a tangram to position in the outline.

● Click and drag ![tangram] onto the workspace.

● Rotate the piece so that it looks like ![rotated tangram]

● Click the ![pointer] and then click the tangram to flip it horizontally.

● Click the ![pointer] to activate the pointer again. You can now drag the tangram into the outline.

5 Fill in the outline with other tangram pieces.

● Click and drag 2 ![tangram] and 2 ![tangram] tangrams onto the workspace.

● Rotate or flip certain tangrams so that the pieces can be positioned in the outline as seen to the right.

● Click and drag the tangrams into the outline to fill it completely.
Exploring Solids

Click ▼ to see the drop-down menu and select Exploring Solids. Fifteen solids are available for you to explore their characteristics from different perspectives.

- After a solid is placed in the workspace, you can rotate it or unfold it to see its net.
- You can drag as many solids onto the workspace as will fit.

Practice Exploring Solids: Pentagonal Prism

1. Choose a solid to explore.

2. Rotate the solid.
   - Click ▼, and then click and hold on the solid (do not release it). Move the cursor left and right to rotate it on the vertical axis. Unclick the solid so that it looks like.
   - Click ▼, and then click and hold on the solid (do not release it). Move the cursor up and down to rotate it on the horizontal axis. Unclick the solid when done viewing the rotation.

3. View the net of the solid.
   - Click ▼. Click on the solid. It will unfold so that you can see all of its faces that form the net of the prism.

4. Fold the net together to view the solid.
   - Click ▼. Then click on the net.
   - The net will fold up so you can see how to put it together to form a solid and how it looks in solid form.

5. You can click ▼ ▼ ▼ in the left side solids menu to view other solids to explore.
Building Nets

Six prisms and six pyramids are available for which you can build nets that form the geometric solid. To get to the Building Nets mode, click to see the drop-down menu and select Building Nets.

- You can rotate and relocate the shapes that make up the net.

Practice Building Nets: Rectangular Prism

1. Choose a geometric solid for which to build a net.
   - Click . Move the cursor over the icon for rectangular prism and click.
   - The prism appears in the upper-right of the workspace, and the pieces that form the net are in a pile in the middle.

2. Put similar pieces of the net together.
   - Click and drag each piece from the center away from the pile.
   - On the left side of the workspace, place the 2 shapes together. Place the 2 shapes together. Place the 2 shapes together.
   - Rotate each piece by dragging any corner of the shape in a clockwise or counterclockwise direction. Organize the pieces like this:

3. Put the four side pieces together.
   - Drag one to the left-center of the workspace to start the net.
1. Drag one green piece just to the right of the green piece. They will snap together at a dotted line.

2. Drag the other green piece to the right of the last piece that you placed.

3. Drag one green piece just to the right of the last piece that you placed. This will form a long rectangle with the four pieces.

4. Put the top and bottom pieces of the prism onto the net.

   - Drag one green piece so that it connects to the top of the second piece from the left of the net.

   - Drag the other green piece so that it connects to the bottom of the same piece of the net. The net is now complete.

Additional Features

- Click 🖨️ to print the net.

- Use 🖥️ to move the net in the workspace.
Input-Output Machine

Explore Creating a Table of Input-Output Values
You can see results for the input and output of a particular rule.

● You can set a rule by clicking on the machine to change the operation and number for the rule.

● Make sure that the mode displays in the upper-left corner.

● You can drag each input number tile, such as , down to the machine and it will give an output that is shown in the table.

Practice Using the Input-Output Machine
1 Find 6 input and output values using the rule +9 and then the rule −4. Then, graph the values.

2 Click on the machine to change the rule.

   ● Use the to change the operation to +.

   ● Use the and to change the rule value to 9.

   ● Click “OK” to save the rule.

3 Add a second machine to the workspace.

   ● Click the button in the bottom shell.

4 The rule dialog for the second machine opens.

   ● Use the to change the operation to −.

   ● Use the and to change the rule value to 4.

   ● Click “OK” to save the rule.

5 Make sure the “Show Table” box above the Input-Output table is checked.

6 Drag the number tile down to the so that it passes through both machines. The output should be 6, since 1 + 9 − 4 = 6.
The input and output values will appear in the first row of the table.

7 Drag tiles numbered 2, 3, 4, and 5 down to the so that they pass through both machines.

The input and output should appear in the table on the right. The last input tile that goes through the machine, 5, is the last one to appear in the table.

8 Click the button. Enter “10” on the keypad and click “OK”.

 Drag the number tile down to the so that it passes through both machines.

This will give you the sixth input/output value for the rules, which appears as the last row in the table.

9 You can see a graph that represents the values in the table with values by clicking the button.

 Clicking on a point on the graph will show its ordered pair as \((x, y)\) with \(x\) being the input and \(y\) being the output.

**Additional Features**

- Use the buttons to the bottom right of the graph to view the data in different ways.

- You can print the table of input and output values by clicking .
**Input-Output Machine**

**Predict the Output**
You can enter values for the “Output” column and check to see if you predicted the correct output values to match the input values and the rule. Click to see the drop-down menu and select Predict the Output.

- You can set a rule by clicking on a machine to change the operation and number for the rule.
- You can enter a value in the “Output” column of the table by clicking on the blank box. A keypad will pop up in which you can enter a number for the predicted outcome.

**Practice Using the Input-Output Machine**

1. Find the output values when the input values are 0, 2, 4, 6, 8, 10, and 12 with a rule . Click on the machine to change the rule.
   - Use the to change the operation to ÷.
   - Use the and to change the rule value to 2.
   - Click “OK” to save the rule.

2. Make sure the “Show Table” box is checked and the “Check Output” box is NOT checked.

3. Click on the first blank box under the “Output” column to enter a value for the output. Click “Enter” to save the number you enter.
   The correct output should be “0”.

4. Click on the remaining blank boxes to enter the output values for each given input value.
   - All the number tiles above the machine should no longer be transparent.

5. Check to see if your output values are correct by checking.
   - All Output values that are correct will have a next to it.
   - All Output values that are not correct will have a next to it.
You can see a graph that represents the table with Output values that you entered by clicking the **Show Graph** button in the bottom shell.

- Clicking a point on the chart will show its ordered pair as \((x, y)\) with \(x\) being the input and \(y\) being the output.
Reading and Comparing the Temperature on the Thermometer

You can show different temperatures on a thermometer in both degrees Fahrenheit and degrees Celsius.

- You can check and uncheck the boxes on the bottom of the workspace to show or hide degrees Fahrenheit or degrees Celsius.
- You can show the change or difference between two temperatures by toggling to Difference mode.

Practice Using the Thermometer

1. Find the temperature in degrees Celsius when it is 82°F Fahrenheit.
   - Check and uncheck the boxes on the workspace.
   - Make sure both the Fahrenheit and Celsius boxes are checked in the bottom shell.
   - Uncheck the box that shows the Celsius temperature located in the upper-right corner of the workspace.

2. Drag the up to 82°F Fahrenheit.
   - The upper-left corner of the workspace should display 82°F.

3. Estimate the temperature in degrees Celsius on the thermometer.
   - Focus on the right side of the thermometer, which shows the degrees in Celsius. The temperature is where the line crosses the thermometer or the point where the thermometer is filled in red.

4. Check the box in the upper-right corner of the workspace so that the temperature in degrees Celsius displays so you can check your estimate.
   - The temperature should read close to 28°C.
Exploring Different States of Water
See how water changes at different temperatures.
1 Click the “Reset All” button in the top shell above the workspace. Then click OK.
2 Check the “Show water state” box.
3 Drag the up and down to see at what temperature water freezes and boils.

Finding the Difference between Two Temperatures
If the temperature during the day rises from 64˚ Fahrenheit to 82˚ Fahrenheit, what is the change in temperature in both Fahrenheit and Celsius?
1 Find the difference between two temperatures.
   ● Click the “Reset All” button in the top shell above the workspace. Then click OK.
2 On the bottom shell, toggle to Difference mode.
3 On the left side of the Thermometer, drag the up to 64˚ Fahrenheit.
   ● Then, drag the up to 82˚ Fahrenheit.
4 The difference in temperature in degrees Fahrenheit and degrees Celsius from the start temperature to the end temperature is now displayed.
   The change in degrees Fahrenheit is .
   The change in degrees Celsius is .
Measuring Cylinders

Solving Capacity Number Stories and Word Problems

To view the containers mode, change [Thermometers] to Containers by clicking the down arrow from the top shell.

The workspace provides an automatic check system.

You can show the capacity of water in a container as water is added or taken away at different intervals.

- You can add water to the container by clicking .
- You can take away water from the container by clicking .
- You can change the capacity of the container by clicking or next to “Capacity”.
- You can change the markings on the container by clicking or next to “Interval”.

Practice Using the Container

For a 500-unit container, how many hours will it take to fill the container if water is pumped in at a rate of 25 units per hour?

1. Adjust the settings to best fit the situation.
   - Click on next to “Capacity” to change the capacity from 100 to 500.
   - You can also change the interval of the marks shown on the container. The choices are 5, 10, or 50. An interval of 10 will have a mark at every 10 units going up to 500 units.
   - Change the number in the box that has the button by clicking inside the units box. Using the keypad, insert the number 25, then click the Enter button.
   - You may want to also enter the same number (25) in the units box of the button to double-check your answer later.

2. Fill the container with water until you reach 500 units.
● Click [+] as many times as needed to reach the top of the container (500 units). When the water reaches the maximum capacity, the [+] button will be disabled.

● Keep track of how many times you click the [+] button. This will give the number of hours it takes to fill the container.

3 Drain the container of water until the container is empty.

● Click [-] as many times as needed to reach the bottom of the container (with no water shown).

● A good way to check your answer from Part 2 when you filled up the container with water is to keep track of how many times you click the [-] button. The number of [+] clicks and [-] clicks should match if each is set to the same number of units (25).
Money

Equivalent Money Amounts
You can find different combinations of bills and coins that equal the same amounts.

- Use 📋 and 📋 to exchange money.
- Use 📋 when you want to arrange the displayed money from greatest to least.
- Use 📋 to view different formats for writing the amount.

Practice Using Money
1. Show the same amount of bills and/or coins in both workspaces.
   - Click 📋 to view the two-part workspace.
   - Click 📋. Place $1 in each part of the workspace. Notice the Odometers show $1.00.

2. In the right workspace, use 📋 to exchange money.
   - Click the 📋 on the $1 bill. Notice the exchange to 2 half dollars.
   - Click the 📋 on the 2 half dollars. Notice the exchange to 4 quarters. Use 📋 to move the coins as needed for better viewing.
   - Click the 📋 on 2 quarters. Click the 📋 on 4 dimes.
   - Notice the Odometer still shows $1.00. So, $1 is the same as 2 quarters and 10 nickels.

3. In the right workspace, use 📋 to exchange money.
   - Click the 📋 to highlight 2 quarters. Click the 📋 to exchange to a half-dollar.
**Click the** [pointer] **to highlight 2 nickels. Click the** [exchange] **to exchange into a dime. Repeat until all nickels are exchanged.**

4 The amount shown in each Odometer is still $1.00. So, $1 is the same as one half-dollar and 5 dimes.

5 Click [360°] to see the amount written as cents. Click [360°] again for the amount in words.

**Additional Features**

- Use the [copy] to make copies of money within the workspace.

- Click the [100] to work with denominations of money that are multiples of 10.

- You can use [compare] to compare two amounts of money. Click [360°] to view the multi-part workspace.
Adding Whole Numbers, Fractions, and Decimals

You can add whole numbers, fractions, and decimals using a number line.

● The two-part workspace provides 2 number lines that can be set for whole numbers, fractions, or decimals.

● Use \( \text{Number Line} \) to set the number line to whole numbers, fractions, or decimals as needed.

Practice Using a Number Line

1. The number line is set for whole numbers from 0 to 10 by default.

   ● Drag a \( \text{number} \) onto the 3 and a \( \text{number} \) onto the 7. Use the number line to determine what must be added to 3 to equal 7.

   Drag 4 \( \text{number} \) onto each whole number between 3 and 7. So, \( 3 + 4 = 7 \).

2. Select the top number line by checking the checkbox. Use \( \text{Number Line} \) to set the number line to fractions. Set the minimum to 0/1, the maximum to 4/1, and the interval to 1/4.

   ● Drag a \( \text{number} \) onto 1 1/2.

   ● You can add 3/4 to 1 1/2 by dragging 3 \( \text{number} \) onto to each fractional part to demonstrate that \( 1 \ 1/2 \ + \ 3/4 \ = \ 2 \ 1/4 \).

   ● Use \( \text{Number Line} \) to set the number line to change to decimal form. You can set it up similarly to the fraction mode to demonstrate the addition of decimals.

   ● Use \( \text{Reset All} \) to clear the number line and start over with the default number line.
Adding and Subtracting Whole Numbers

You can add and subtract whole numbers using a number line.

To get to the Add & Subtract Whole Numbers mode, click ⬇️ to see the drop-down menu and select Add & Subtract Whole Numbers.

Practice Adding/Subtracting Using a Number Line

1. Use number lines to create the addition equation 3 + 4.

   ● Under 👇 , drag the red dot to the first number in the equation, 3. Click on the “Set Value.”

   ● In the +/- , click on the + .

   ● Under 👈, drag the green dot to the second number in the equation, 4. Click on the “Set Value.”

   ● In the +/- , click on the - .

   So, 3 + 4 = 7.

2. You can set up a subtraction equation by following the same steps except click - instead of + .

   ● You can add or subtract up to 3 numbers in the equation using the number lines.

   ● Use Reset All to clear the number line and start over with a new equation.
Adding and Subtracting Decimals

You can add and subtract decimals using a number line. Click \( \downarrow \) to see the drop-down menu and select **Add & Subtract Decimals**.

- The workspace provides a number line that can be used to demonstrate the addition and subtraction of decimals.
- The number line can be set to add/subtract tenths or hundredths by clicking on 0.1 0.01.

Practice Adding/Subtracting Decimals Using a Number Line

1. Use number lines to create the subtraction equation 4.7 – 1.8.

   - Under 
     , drag the red dot to the first number in the equation, 4.7. Click on the “Set Value.”
   - In the 
     , click on the 
   - Under 
     , drag the green dot to the second number in the equation, 1.8. Click on the “Set Value.”
   - In the 
     , click on the 
     So, 4.7 – 1.8 = 2.9.
   - You can set up an addition equation by following the same steps except click \( + \) instead of \( - \).
   - You can add or subtract up to 3 decimal numbers in the equation using the number lines.
   - Use \( \text{Reset All} \) to clear the number line and start over with a new equation.
**Adding and Subtracting Fractions**

You can add and subtract fractions using a number line. Click to see the drop-down menu and select **Add & Subtract Fractions**.

- The workspace provides a number line that can be used to demonstrate the addition and subtraction of fractions.
- The number line can be set to add/subtract fractions or mixed numbers by clicking on .

**Practice Adding/Subtracting Fractions Using a Number Line**

1. **Use number lines to create an addition equation.** Find the sum of $\frac{1}{6} + \frac{3}{4}$.
   - Since the first fraction is $\frac{1}{6}$, choose 6 for the denominator. Under , drag the red dot to $\frac{1}{6}$. Click on the “Set Value.”
   - In the , click on the .

2. **To show the fraction $\frac{3}{4}$, choose 4 for the denominator.** Under , drag the green dot to $\frac{3}{4}$. Click on the “Set Value.”
   - To add the fractions, you must have a common denominator. Select 12 as the denominator. So, $\frac{1}{6} + \frac{3}{4} = \frac{11}{12}$.
   - If you select the incorrect denominator, it will leave the numerator blank. Then, you know you need to select a different number for the denominator.

3. **You can set up a subtraction equation by following the same steps except click** instead of .
   - Use **Reset All** to clear the number line and start over with a new equation.
Using Number Lines to Compare Intervals of Different Place Values

You can use a number line to compare intervals of various place values. Click to see the drop-down menu and select Intervals.

- The workspace provides 3 number lines that represent 3 different place values.
- Click on either arrow of to set the bottom number line to show ones, tens, or hundreds place value.
- The number line above each number line is like looking through the magnifying glass on the number line below it to see the smaller units of place value.

Practice Comparing Intervals on a Number Line

1. Use the number lines to show the place on a number line for the number 4.57.
   - Since 4.57 is between 4 and 5, drag the magnifying glass on the ones to show the interval 4 to 5.
   - 4.57 is between 4.5 and 4.6 on the tenths number line. Move up to the tenths line and drag the magnifying glass to show the interval of 4.5 to 4.6.
   - You can change the bottom number line to ones, tens, or hundreds to examine the place values of different numbers.
   - Use to clear the number lines and start over with for a new number.
Number Charts

Skip Counting by Threes
You can skip count using the hundred chart.

● This workspace provides a chart with 100 spaces that can be set to start at any number.

● Use Set Chart to change the number that the chart begins with.

Practice using the Hundred Chart

1 On the bottom shell, click on Skip Counting. You will see a dialog box where you can enter a number to start from and a number to count by.

● Use the button to change the Count on from number to 4.

● Use the button to change the Count by number to 4.

● Click on Start to highlight the first number. Then click on Next to highlight each subsequent number.

2 Use Show All to show all the numbers in the skip counting pattern at once.

● Use Reset All to clear the chart and start a new pattern.

● Change the number in the “Count on from” box to change the starting number of the skip counting.

3 The number you are skip counting by can be changed to any number by changing the number in the “by” box.

   Anytime you want to count by a different pattern, use Reset All to clear the chart and start over.

4 In the bottom shell, click the Circle Primes box. You will see all the prime numbers circled in the Hundred Chart.
Finding Sums

You can find sums using the Addition Chart. To get to the Addition Chart mode, click to see the drop-down menu and select Addition Chart.

● This workspace provides a chart that can be used to find any sum between 0 and 998.

● Use to change the number that the rows and columns start at. The rows and columns can start with any number between 0 and 491.

Practice Using the Addition Chart

1 Find the sum 8 + 9.

● To add 8 + 9, click on in the top row. Then, click on in the left-most column. The sum is the number where the green strips intersect. So, the sum is 9 + 8 = 17.

2 Now, find the sum 246 + 84. Use to start the row to include 246 and the column to include 84. You may use your keyboard or the arrows, and, to insert numbers in the Set Chart box. Then click OK.

● Click on 246 in the left-most column 246 and 84 in the top row. The intersection is at 330. So, 246 + 84 = 330.

Anytime you want to find a different sum, use to clear the chart and start over.
**Number Charts**

**Finding Products**
You can find products using the Multiplication Chart. To get to the Multiplication Chart mode, click \( \checkmark \) to see the drop-down menu and select **Multiplication Chart**.

- The workspace provides a chart that can be used to find any product between 0 and 961.
- Use \( \text{Set Chart} \) to change the number that the rows and columns start at. The rows and columns can start with any number between 0 and 23.

**Practice Using the Multiplication Chart**

1. Find the product \( 6 \times 8 \).
   - To multiply \( 6 \times 8 \), click on \( 6 \) in the left-most column. Then, click on \( 8 \) in the top row. The product is the number where the green strips intersect.
   - So, the product is \( 6 \times 8 = 48 \).

2. Now, find the product \( 18 \times 21 \). Use \( \text{Set Chart} \) to start the rows to include 18 and the columns to include 21. Then click OK.
   - Click on 18 in the left-most column and 21 in the top row. The intersection is at 378. So, \( 18 \times 21 = 378 \).
   - Anytime you want to find a different product, use \( \text{Reset All} \) to clear the chart and start over.

**Additional Features**
You can change the highlighted color of the rows and columns.
- It is especially helpful when you highlight 2 or more rows or columns at the same time.
- The color choices are at the bottom of the workmat. You can click the Paint Brush and Select Color buttons to choose different colors and highlight any product on the Number Chart.
- The Hide Cells button \( \text{Hide Cells} \) lets you hide any numbers that are not part of your equation.
Comparing Numbers

You can compare values on a balance scale.

- The workspace provides a pan balance that can be used to compare two or more numbers.
- Drag numbers onto each side of the balance to see how they compare. The $x$-block can be used to introduce a balanced equation.

Practice Using a Pan Balance to Compare Numbers

1. Click and drag numbers onto each side of the scale to make an equation. Drag 1 and 3 into the left pan and drag 3 and 5 into the right pan.
   - The odometer shows the inequality statement.

2. Use $\rightarrow$ to break apart the 5 in the right pan into 5 ones. Move cubes between pans to make the sides equal. Notice this turns the inequality into an equation.
   - Use $\rightarrow$ to clear the balance and start over.

3. Introduce a variable by using the $x$-block from the menu on the left.
   - Drag $x$ onto the left side of the balance and 6 as a value for $x$ onto the other side. Use $\rightarrow$ to set the variable equal to that value.
   - Now, drag equal or unequal values to both sides of the scale to demonstrate balanced and unbalanced equations. Click the $\rightarrow$ odometer to see the equation as a bar model.
Comparing Symbols

You can compare shapes that have been randomly assigned different values. To get to the Symbols mode, click to see the drop-down menu and select Symbols.

- The one-part workspace provides a balance that can be used to compare two or more shapes of unknown weight.
- Drag symbols/shapes onto each side of the balance to see how they compare.

Practice Comparing Numbers

1. Drag a heart onto one side of the balance and a square onto the other.
   - Compare the weights of each shape.
2. Drag more squares onto the pan balance until the sides are equivalent.
3. Next, find how many squares would be equivalent to one circle.
4. You can use the balance to order the weights of each shape from least to greatest.
5. Click to type the values of the shapes as you find them. If you are correct, you will see a next to the shape.

- Anytime you want to compare symbols using different values, use to clear the balance and start over.
Modeling Numbers

You can model whole numbers using place-value blocks.

- The menu allows you to choose which block will be the unit block. When Small is selected, equals 1. The values of the other blocks are set as 10, 100, and 1000.
- Use to move blocks.

Practice Using Place-Value Blocks

Model the number 4,372.

1. Click . Place one Large cube in the workspace for each thousand in the number being modeled. Use 4 .
2. Click . Place one Flat in the workspace for each hundred in the number. Use 3 .
3. Click or . Place one Long (either horizontal or vertical) in the workspace for each ten in the number being modeled. Use 7 .
4. Click . Place one Small cube in the workspace for each one in the number being modeled. Use 2 .
5. Click to arrange the blocks in an organized way.
6. Click to display different ways of naming that number. Click one time for the Odometer to show the number in words. Click again for the Odometer to show the standard form of the number: 4,372.
- Click to show the place-value chart. Notice that the blocks in the workspace are positioned in the proper columns and the Odometer shows the number: 4,372. Click to close the place-value chart.
Place Value Blocks

Multiplying Numbers
You can find the product of two numbers using an array. To get to the Arrays mode, click to see the drop-down menu and select Arrays.

- Click on the in the upper right corner of the array box and drag to resize the array.

Practice Using the Array Workspace
Model the multiplication problem $27 \times 23 = 621$.

1. Click and drag to set the factors of a multiplication problem. Use 27 along the vertical scale and 23 along the horizontal scale.
2. Begin to fill the rectangle with blocks.
   - Click . Place the block in the lower left corner inside the rectangle.
   - Click the on the block in the rectangle to copy a in the rectangle.
   - Continue to click the on a in the rectangle until it appears that no more can fit inside the rectangle. (Click 3 times.)
3. Continue placing blocks in the rectangle until it is filled.
   - Click . Place a above the upper left .
   - Click the on the to copy another inside the array.
4. Continue to click the on a until it appears that no more can fit inside the rectangle. (Click 13 times.)
   - Place 6 inside the rectangle.
   - Place to fill the rectangle. Place 21 Small cubes.
   - The multiplication problem solved is $27 \times 23 = 621$.
   - Check “Auto Fill” to automatically fill the array.
Place-Value Blocks

Comparing Numbers

You can compare numbers using place-value chips. Click to see the drop-down menu and select **Place-Value Chips**.

- Use the workspace. Actions are applied in this workspace only.
- Use to copy selected chips.

Practice Using Place-Value Chips

1. Place chips in the left workspace to represent a number having digits in the thousands, hundreds, tens, and ones places. Use 1,381.
   - Place 1 . Place 3 . Place 8 . Place 1 .
   - Click once to show the word form of the number in the Odometer. Notice that the Odometer may not display the complete number word in the window. Click on the Odometer window to display the complete text.
     - Click again to check that the left Odometer shows 1,381 in standard form.
   - Click to arrange the blocks in an organized way.

2. Click to show the place-value chart. Notice the number in each place-value column. Click to close the place-value chart.

3. In the middle workspace show a number that is 100 more than 1,381.
   - Use and drag a rectangle around all the chips in the left workspace.
   - Click and click on any selected (blue highlighted) chip.
   - Click . Click and hold on one of the blue highlighted chips and drag the group into the middle workspace.
● Place one more 🌿 in the middle workspace to add 100 to 1,381.

● Click 🔄 two times and check that the middle Odometer shows 1,481.

4  In the right workspace show a number that is 50 less than 1,481.

● Select and copy the chips in the middle workspace. Move the copied chips into the right workspace.

● Use 🔄 to take away 50. Click the 🔄 on 5 🌿.

● Check that the right Odometer shows 1,431.

● Click 🔄 on the lower odometer two times to show the numbers in standard form. This will show the total of all three workspaces. Check that the lower odometer reads 4,293.

Additional Features

● Click the 🔄 to break the place-value chips or place-value blocks into smaller units.

● You can use 🔄 to combine smaller units into a larger unit. Select a group of ten chips or blocks of the same value, such as ones chips, and click 🔄.
Finding a Missing Part

The workspace provides an automatic check system.
You can see how a value can be split into 2 parts, where the sum of the parts equals the whole.

- You can input a number and divide it into 2 parts. The parts can be equal or not equal to each other. An equation is shown to match the diagram.
- Make sure that the mode displays \textbf{Part-Part-Whole: Addition and Subtraction} in the upper-left shell.
- You can click on the \textbf{+} to change the equation from addition to subtraction.

Practice Using Part-Part-Whole

1. Find the missing part of the equation $80 + ? = 250$.
2. Click on the box above the strip diagram in the workspace.
   - Enter 250 next to “Enter a value” or enter using the numeric keypad. Then click OK.
3. Click the \textbf{hide} button in the bottom shell of the workspace to hide the right part. The equation should change from $125 + 125 = 250$ to $125 + ? = 250$.
4. Drag the \textbf{strip} so that the strip diagram shows 80 for the first part and “?” for the second part.
   - The equation should now read: $80 + ? = 250$
5. Find the value of the missing part, or the “?,” to make the equation true.
   - Click the \textbf{show} toggle button that to show the full equation with the missing part, to see if your answer is correct.
Comparing Parts to the Whole

To view the Part Comparison mode, click to see the drop-down menu and select **Comparison: Addition and Subtraction**.

You can see how a value compares to 2 parts, where the sum of the parts equals the whole.

- You can input a number and divide it into 2 parts. The parts can be equal or not equal to each other. An equation is shown to match the diagram.

- You can click on the to change the equation from addition to subtraction.

**Practice Using Comparison: Addition**

1. Find the sum of two parts $150 + 66 = ?$.

2. Click the toggle button in the bottom shell of the workspace to hide the whole. The equation should change from $10 + 10 = 20$ to $10 + 10 = ?$.

3. Click on the left part of the strip diagram in the workspace.

- Enter 150 next to “Enter a value” or enter using the numeric keypad. Then click OK.

4. Click on the right part of the strip diagram

- Enter 66 next to “Enter a value” or enter using the numeric keypad. Then click OK.

The equation should now read: $150 + 66 = ?$.

5. Find the value of the missing whole, or the “?,” to make the equation true.

- Click the toggle button that to show the full equation with the whole, to see if your answer is correct.
Finding Equal Parts

To view the Equal Parts mode, click ☑ to see the drop-down menu and select Equal Parts: Multiplication and Division.

The workspace provides an automatic check system.

You can see how a value can be split into various parts and how parts can be multiplied to make a value. These parts can be whole numbers or fractions.

- You can click on × to change the equation from multiplication to division.

Practice Using Equal Parts

1. Divide 40 into 5 equal parts. Find the value of the parts.
   - Click on the top box in the workspace.
   - Enter 40 next to “Enter a value” or enter using the numeric keypad. Then click OK.

2. Click the toggle button in the bottom shell of the workspace. The equation should change from $2 \times 20 = 40$ to $2 \times ? = 40$.

3. Make sure that the Whole Numbers button is selected in the left part of the bottom shell.

4. Click on the right arrow located under the strip diagram until the box shows “5.” The equation should now read: $5 \times ? = 40$.

5. Find the value of the 5 equal parts, or the value of the “?,” to make the equation true.
   - Click the toggle button to show the full equation with the missing part, to see if your answer is correct.

6. Divide 12 into 8 equal parts. Find the value of the parts.

7. Click the “Reset All” button in the top shell above the workspace. Then click OK.

8. Click on the top box in the workspace.
   - Enter 12 next to “Enter a value” or enter using the numeric keypad. Then click OK.
9 Click the toggle button in the bottom shell of the workspace. The equation should change from $2 \times 6 = 12$ to $2 \times ? = 12$.

10 Make sure that the fractions button is selected in the left part of the bottom shell.

11 Click on the right arrow after the “Number of parts,” located under the strip diagram, until the box shows “8”. The equation should now read: $8 \times ? = 12$

12 Find the value of the 8 equal parts, or the value of the “?,” to make the equation true.

   Click the toggle button to show the full equation with the missing part, to see if your answer is correct.
Comparing Factors

To view the Factor Comparison mode, click ☑️ to see the drop-down menu and select **Comparison: Multiplication and Division**.

The workspace provides an automatic check system.

You can see how parts can be multiplied to make a value and compare the parts to the whole. These parts can be whole numbers or fractions.

- You can click on ✗ to change the equation from multiplication to division.

**Practice Using Comparison: Multiplication**

1. Multiply $7 \times 3$.
   - Click on one part of the strip diagram in the workspace.
   - Enter 3 next to “Enter a value” or enter using the numeric keypad. Then click OK.

2. Click the [ ] toggle button in the bottom shell of the workspace. The equation should change from $2 \times 3 = 6$ to $2 \times 3 = ?$.

3. Click on the right arrow located under the strip diagram until the box shows “7.”
   - The equation should now read: $7 \times 3 = ?$.

4. Find the value of the product, or the value of the “?,” to make the equation true.
   - Click the [ ] toggle button to show the full equation with the missing part, to see if your answer is correct.
Creating Diagrams

To view the Create a Strip Diagram mode, click ▼ to see the drop-down menu and select **Create a Strip Diagram**.

You can construct a strip diagram to model any situation.

**Practice Creating a Strip Diagram**

1. Model the problem $75 \div 15$.

   - Click on a medium-sized tile from the palette and drag it into the workspace.
   - Click on the tile and enter $75$ next to “Enter a value”. Then click OK.
   - Click on the smallest tile from the palette and drag it to line up with the left side of the first tile.
   - Click on the tile and enter $15$ next to “Enter a value”. Then click OK.
   - Click on the icon and drag it into the workspace.

   This strip diagram models $75 \div 15$.

2. Model the problem $75 \div 15 = 5$.

   - Select and click on the $15$ tile to make 4 copies.
   - Use the to drag the arrow out of the way, and then line up the $15$ tiles below the tile.

   - Use the to resize the large tile to match the length of the 5 smaller tiles.

   This strip diagram models the problem $75 \div 15$ and its solution, 5.

**Additional Features**

- Use to erase an element from the workspace.