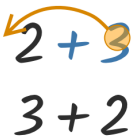
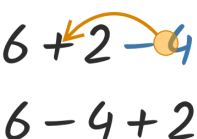
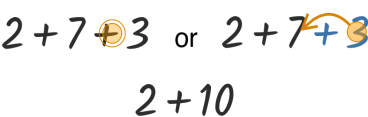
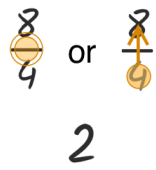
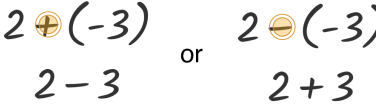
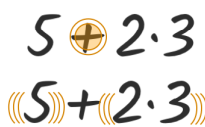

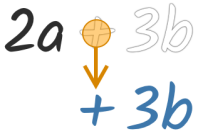
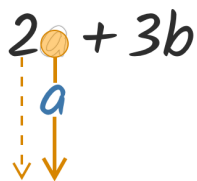


## Frequently Used Gestures in Graspable Math





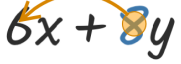






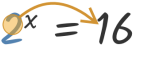
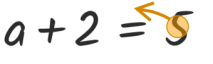
Tap, drag, and hold terms in Graspable Math to rewrite mathematical expressions into equivalent ones:

1. *Click or tap*: apply an operation (e.g. “+”) or resolve parentheses (“(”).
2. *Tap + drag*: drag terms where you want them to go to trigger the corresponding transformation. GM indicates valid places to drop a term with blue rectangles.

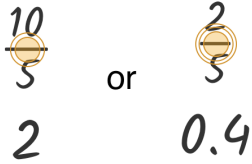
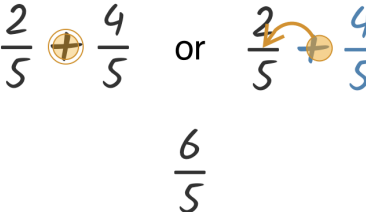
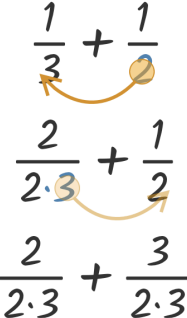
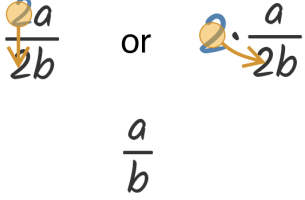

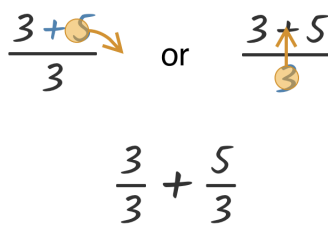
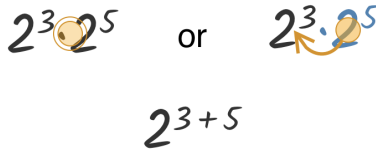
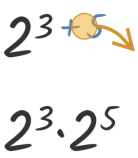
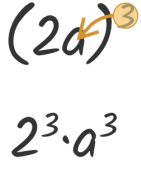
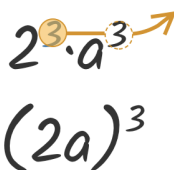

### Operations, Commutative Property, Factoring

<p><b>Commute Terms</b> Drag terms to commute.</p>  <p><math>2 + 3</math> <math>3 + 2</math></p>	<p><b>Commute Negative Terms</b> In GM, a + or - is picked up with the term, so you can commute with negative terms.</p>  <p><math>6 + 2 - 4</math> <math>6 - 4 + 2</math></p>	<p><b>Perform Operations I</b> Tap on operators or drag terms onto each other to add, subtract, multiply, etc</p>  <p><math>2 + 7 + 3</math> or <math>2 + 7 + 3</math> <math>2 + 10</math></p>
<p><b>Perform Operations II</b> Tap the division bar or drag terms onto each other to divide.</p>  <p><math>\frac{8}{4}</math> or <math>\frac{8}{4}</math> <math>2</math></p>	<p><b>Combining Signs</b> Tap the left sign to resolve “+-” and “-+”.</p>  <p><math>2 + (-3)</math> or <math>2 - (-3)</math> <math>2 - 3</math> or <math>2 + 3</math></p>	<p><b>Order of Operations</b> When tapping an operator that can't be applied, GM will shake the terms.</p>  <p><math>5 + 2 \cdot 3</math> <math>((5)) + ((2 \cdot 3))</math></p>
<p><b>Decompose and Factor Numbers</b> Select “keypad” mode and tap on a number to replace it with an equivalent expression.</p>  <p><math>12</math> <math>6 \cdot 2</math></p>	<p><b>Picking Up Multiple Terms I</b> Pick up groups of terms by their operator or brackets around them, or fraction bar.</p>  <p><math>2a</math> <math>3b</math> <math>+ 3b</math></p>	<p><b>Picking Up Multiple Terms II</b> Pick up groups of terms by dragging down a term until more terms snap to it.</p>  <p><math>2a</math> <math>+ 3b</math></p>

## Distributive Property, Rearranging Equations

<p><b>Distribute a Term</b> Drag a term into parentheses to distribute. Automatically simplifies in advanced settings</p>  $2 \cdot (3 + a)$ $2 \cdot 3 + 2a \text{ or } 6 + 2a$	<p><b>Distribute a Negative Sign</b> Tap on the negative sign to distribute.</p>  $2x - (x - 3)$ $2x - x + 3$	<p><b>Distribute Multiple Terms</b> Drag one sum in another to distribute. Double-tap "(" instead to skip line 2 below.</p>  $(x + 2) \cdot (x - 2)$ $x \cdot (x - 2) + 2 \cdot (x - 2)$ $x^2 - 2x + 2x - 4$
<p><b>Factor a Term</b> Drag common terms onto each other to apply the distributive property.</p>  $2 \cdot 3 + 2a$ $2 \cdot (3 + a)$	<p><b>Finding Greatest Common Factors</b> When numbers don't match, GM finds their greatest common factor.</p>  $6x + 8y$ $2 \cdot 3x + 2 \cdot 4y$	<p><b>Factoring Multiple Terms</b> You can factor groups of terms, too.</p>  $x \cdot (x - 2) + 2 \cdot (x - 2)$ $(x + 2) \cdot (x - 2)$
<p><b>Equations: Do the Same to Both Sides I</b> Tap the "=" and enter an operation to apply to both sides in the keypad.</p>   $a + 2 = 5$ $a + 2 - 2 = 5 - 2$	<p><b>Equations: Do the Same to Both Sides II</b> Drag a term to the other side of the equation to apply the inverse.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <math display="block">a + 2 = 5</math> <math display="block">a + 2 - 2 = 5 - 2</math> <p>(auto-simplify setting off)</p> </div> <div style="text-align: center;">  <math display="block">a + 2 = 5</math> <math display="block">a = 5 - 2</math> <p>(auto-simplify setting on)</p> </div> </div>	
<p><b>Equations: Invert Power I</b> Drag the exponent across the "=" to invert it.</p>  $x^2 = 4$ $x = \pm\sqrt{4}$	<p><b>Equations: Invert Power II</b> Drag the base across the "=" to apply the logarithm to both sides.</p>  $2^x = 16$ $x = \log_2(16)$	<p><b>Equations: Swap Sides</b> Drag one side of the equation above the "=" to swap sides.</p>  $a + 2 = 5$ $5 = a + 2$

## Fractions and Powers

<p><b>Turn Fraction into Decimal</b> Tap on the fraction bar to compute. If the result is not an integer, double-tap.</p> 	<p><b>Adding Fractions I</b> Tap or drag to add fractions with common denominators.</p> 	<p><b>Adding Fractions II</b> To rewrite fractions to have the same denominator, drag one denominator onto the other one. (Short-cut: double-tap "+")</p> 
<p><b>Canceling Fractions</b> Drag matching terms on top of each other to cancel them out.</p> 	<p><b>Nested Fractions</b> Drag a fraction out of the denominator to invert it.</p> 	<p><b>Distribute Denominator</b> Drag and add out of the numerator or the denominator onto the numerator.</p> 
<p><b>Multiply Powers</b> Tap the "*" or drag to multiply powers.</p> 	<p><b>Split Powers</b> Drag an addend out of an exponent to split a power. (You may use keypad mode to replace an exponent with a sum first.)</p> 	<p><b>Distribute Exponents</b> Drag an exponent into a product to distribute it.</p> 
<p><b>Factor Exponents</b> Drag an exponent over matching exponents to pick them up, then drop them next to the product.</p> 	<p><b>Move Powers Across Fractions</b> Drag a power across the fraction bar to invert the exponent.</p> 	<p><b>Negative Exponent → Fraction</b> Drag a power with a negative exponent down and drop it to create a fraction.</p> 