



What is the purpose of this program?

Stamp It! gives students opportunities to describe number patterns with algebraic expressions. They “stamp” a number grid, which selects a few cells in a particular arrangement. They then look for relationships between the value of the cell labeled n and the values of other cells in the stamp.

Students write expressions, test them against their data, and explain why their formula works. These steps help them to deepen their understanding of algebra: how a variable can represent an infinite number of situations, how to simplify an expression, and what it means for two expressions to be equivalent.

User Guide

Contents at a glance

- [The Stamp It! Interface](#) (page 2)
- [Writing Expressions](#) (page 4)
- [Column and Grid Settings](#) (page 4)
- [Choosing and Modifying Stamps](#) (page 5)
- [Grids Without Numbers](#) (page 6)
- [Saving, Opening, and Printing Your Work](#) (page 9)
- [Questions for Investigations](#) (page 9)

The Stamp It! Interface

The main features of the program interface are the number grid and its controls on the left (highlighted in brown), the data and conjecture table on the right (blue), and the stamp display and **Choose Shape** button in the upper right (purple).

- The grid is where patterns are stamped to generate data and where the relationships between the values in the cells can be studied.
- The Conjectures table is where you look for numerical patterns and build expressions to represent those patterns. A conjecture is a relationship you believe will work; an expression gives you a way to describe and test it. Once your expression matches the data and you can explain why it works for every case, you have justified your conjecture. At that point, it is not a conjecture any longer – it is a true formula!
- The stamp display shows you the arrangement of cells in your stamp, which cell is the anchor cell represented by the variable n , and which cells are also represented by variables (a and, if used, b). The **Choose Shape** button opens a window that provides many different stamp designs; the ability to move which cell is associated with n , a , and b ; and the option to design your own stamp (including introducing negative cells).

Stamp It!

Save Open Save PDF

Number grid

Grid Width: 6 Count by 1

Counting 5 12 1 12

☐ Cycle shades ☐ Use variable width w ☐ Use variable count by c

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
49	50	51	52	53	54
55	56	57	58	59	60
61	62	63	64	65	66

5 locations stamped Undo Add Rows

Your stamp

T Pointing Right - 4 colored cells

Choose Shape

Conjectures

Add Column

n	Actual value	Your expression	Actual value	Your expression
Sort ↑	a	$n+6$	Sum	$3n+28$
7	13	✓ 13	29	≠ 49
37	43	✓ 43	149	≠ 139
27	33	✓ 33	109	✓ 109
41	47	✓ 47	165	≠ 151
52	58	✓ 58	209	≠ 184

1. a : Matches 5 of 5 examples - four or more distinct matches
2. Sum: Matches 1 of 5 examples

You may have up to three columns at a time. You may use them for different values or to compare different expressions for the same value.

If your expression has successfully matched at least four values, they will be highlighted in bold green. Although examples are not a guarantee of correctness, for this setting it is very difficult to match four values and not have a correct expression.

Find the pattern.

Stamp the grid. Build an expression. Test your idea.

The Grid

In the screenshot above, the number grid is 6 cells wide, the numbers start at 1, and they count by 1. This grid arrangement is controlled by the dropdown menu and two sliders above the grid. The Grid menu includes options to start at 1 (**Counting**), at 0 (**Whole**), or to show values in both the positive and negative direction (**Integers**). It also has an option, **No Values**, which shows a blank grid, which means the user has to consider the tasks more abstractly. The grid example that follows shows a grid 9 cells wide with integers

counting by 4. The grid scrolls vertically and, for **Counting** and **Whole** grids, additional rows can be added (up to a value of 9999) with the **Add Rows** button. The **Cycle shades** checkbox makes adjacent stamps distinguishable.

When the mouse cursor is over the grid, a preview of the stamp shape appears with the n cell at the cursor's location. When stamping a new copy of the shape, all cells must fit within the current grid (without wrapping around) and must not overlap a pre-existing instance of the shape. If you want to remove a stamp, in order to place a different one that would be blocked by it, click the **Undo** button below the grid.

The Conjectures Table

When using the **Counting**, **Whole**, or **Integer** options, each time a new stamp is added to the grid, a new row will appear in the Conjectures table. The table will list the value for the cell associated with n and calculations for the values of a , b , **Sum**, or **Product** as chosen from the dropdown menu. New columns start with a as the option. **Sum** adds the values of all orange cells and, if in two-color mode, the opposite of all blue cells. Product multiplies all cell values counting blue cells as the opposite of the value in the cell. An uncolored cell never contributes to either calculation, even if it is marked n .

Use the **Sort** ↑ option in the header for the column of n values to show the examples sorted by increasing size of n . **Unsort** restores the order in which the examples were stamped. An ordered list might help you more readily discover a pattern.

Your goal is to develop an algebraic expression that will generate the values in a column using only the variable n (since a and b need to be understood in terms of n). Once you have an expression to try out, you should click **Enter an Expression**, type your formula using the tools explained below, and click **Submit Expression** (or press Return). The program applies that expression for every value of n in the column. If the value produced by the expression matches the actual value in that column, it will be highlighted in green. Otherwise, it will be orange. When all of the collected examples in a column are successful matches and there are at least four, the matches appear in bold green. A later mismatch would remove the bold emphasis. Multiple matches with no counterexamples are useful evidence that an expression is correct; however, examples are not a proof, so the next mathematical step would be a clear explanation of how the pattern in the shape connects to the expression.

Additional columns can be added with the **Add Column** button. Up to three different columns may be explored at the same time. If the table is wider than the screen, it will be horizontally scrollable. The **x** beside an expression heading removes that column.

You may want more than one column showing the same quantity, so you can try more than one expression at a time for comparison. For example, for the shape **Vertical 2** with a grid width of 6 and **Count by** of 1, a

Number grid

Grid Integer **Width: 9** **Count by 4**

☐ Cycle shades ☐ Use variable width w ☐ Use variable count by c

-180	-176	-172	-168	-164	-160	-156	-152	-148
-144	-140	-136	-132	-128	-124	-120	-116	-112
-108	-104	-100	-96	-92	-88	-84	-80	-76
-72	-68	-64	-60	-56	-52	-48	-44	-40
-36	-32	-28	-24	-20	-16	-12	-8	-4
0	4	8	12	16	20	24	28	32
36	40	44	48	52	56	60	64	68
72	76	80	84	88	92	96	100	104
108	112	116	120	124	128	132	136	140
144	148	152	156	160	164	168	172	176
180	184	188	192	196	200	204	208	212

Sum column with $2n + 6$ and another with $n + (n + 6)$ would show their equivalence. You might study a column with a and another with Sum or Product so you can build up the Sum or Product expression based on the values of n , a , and, if used, b .

Writing Expressions

Once **Enter an expression** has been clicked, a window appears for entering and editing expressions. Both explicit ($3*n$) and implied ($3n$) multiplication are supported. Fractions and exponents can be inserted with the $\frac{a}{b}$ and a^b buttons.

Type “ n ” or use the button to represent the value in the cell marked “ n ”. The variables a and b identify cells you can place in your shape, but they are not values you can type into an expression. Expressions are only in terms of n , until, after some experience, you try [grids](#)

[without numbers](#). In **No Values** mode, you can also generalize for the width of the grid, w , the counting-by amount, c , or both as additional variables that you can incorporate in your expressions.

Fractions and Exponents

Fractions: The $\frac{a}{b}$ button inserts a fraction. Enter the numerator above the solid fraction bar and the denominator below it. Shading and a dashed underline show the active typing area. You can click to different locations in the expression or navigate left, right, up, and down (for fractions and exponents) with the arrows. At the end of an entry, the Right Arrow or Tab leaves a fraction.

Exponents: The a^b button inserts a raised entry after a base; to square a value, enter the base first, click the button, then type “2” in the raised entry box. Exponents must be integers. In addition to the exponent button, the caret symbol, “^”, and the Up Arrow start an exponent. Down, Right, or Tab leaves it.

Clear clears the draft in the editor. **Submit Expression** puts your edited expression in the table; **Cancel** or Escape leaves the earlier expression in place. If an entry is incomplete (for example, “ $n +$ ”), the editor stays open and asks you to fix it.

Column and Grid Settings

Changing the Number Grid

The **Counting** option in the Grid drop-down menu starts the grid at 1. **Whole** starts it at 0. **Integer** includes negative numbers, zero, and positive numbers. The **No Values** setting hides the numbers, so you can reason about a general location; this option is discussed further in [Grids Without Numbers](#) on page 6.

Expression conjecture

Write an expression for a . Use n for the number at the stamp's anchor.

$$\frac{n^2 - 4}{n + 3}$$

Insert

$\frac{a}{b}$

a^b

n

(

)

Clear

Typing: Use +, −, ×, ÷, decimals, and parentheses. Press Enter to submit.

Exponents: Press ^ or ↑ to start an exponent. Press ↓, →, or Tab to leave it.

Fractions: Use ↑ and ↓ to move between the top and bottom. Press → at the end of an entry, or Tab, to leave the fraction.

Deleting: Press Backspace just after a fraction or exponent, or Delete just before it, to remove it.

Cancel

Submit Expression

The **Width** slider chooses 5 through 12 cells per row. **Count by** chooses a step between cells from 1 through 12. **Count by 3** with the **Counting** option, for example, starts the first row 1, 4, 7, ...

Changing the grid, width, or counting step clears stamped examples but keeps expressions that are still allowed. Does your old rule still provide clues to the new arrangement? **Undo** restores the previous grid setting and work. **Add Rows** extends a numbered grid by up to 20 rows at a time; the program stops before a complete row would contain a value above 9,999. **Integer** and **No Values** grids do not have this button.

Choosing and Modifying Stamps

To try one of the many possible shapes, click the orange **Choose Shape** button. Scroll through the **Built-in stamps** and select a pattern. The preview lets you choose where n , a , and, if desired, b go before you commit to the new stamp.

Choose **Set n** , then click the cell that should be n . This is the cell you position when you stamp the grid. Choose **Set a** or **Set b** , then click a colored cell. Each variable needs its own cell. The n cell may be uncolored, which is useful for stamps with gaps; a and b must be on colored cells.

The program chooses an initial location for n and a . Check them in the preview and move either, if you wish. The variable b is optional. **Remove b** takes away the variable without removing its cell. If b is not used, its table menu entry is grayed out.

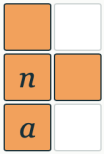
Click **Choose Stamp** to confirm your choices. Changing the shape, colors, or variable locations clears the earlier examples and expressions, so save work you want to keep first. **Cancel** or Escape leaves the current investigation alone. If you choose the shape Horizontal Separated Pair Widest, which is 7 cells wide, and the grid width is less than 7, the choose button will also offer to widen the grid.

Two-Color Sums and Products

Two-color mode operates on orange cell values as they are displayed and uses the opposite of blue cell values (their sign is reversed) when calculating Sum and Product columns. In **Choose Shape**, check **Two-color mode**. Choose **Orange +** or **Blue -**, then click a cell to count the cell value, when orange, or its opposite, when blue, for both the Sum and Product patterns. The selected color tool has a checkmark and outline.

For **Sum**, the program will add orange-cell values and subtract blue-cell values. For **Product**, the program will multiply orange-cell values with the opposite of the blue-cell values. Blue does not change the number displayed in a cell or the formula for a .

T Pointing Right
4 colored cells - 2 wide x 3 high

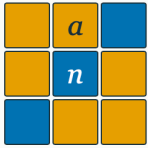


☐ Two-color mode

Set n Set a Set b

Select a colored cell for b . Each variable needs its own cell.

Solid 3 x 3
9 colored cells - 3 wide x 3 high



☒ Two-color mode

Orange + ✓ Blue - Set n Set a Set b

Select a colored cell to use its opposite (blue) in Sum and Product.

Creating Your Own Stamp

In **Choose Shape**, select the **Create Your Own** tab to design your own shape. The 5×5 board is a design area for your stamp.

Built-in Stamps
Create Your Own

Draw on a 5×5 board

Turn cells on or off with Draw Cells. Your stamp can have gaps and separate pieces.

Custom stamp

11 colored cells · 5 wide × 5 high

☐ Two-color mode

Draw Cells
Set n
Set a
Set b
Remove b

Select a colored cell for b . Each variable needs its own cell.

n is uncolored and excluded from Sum and Product. a is already placed on a colored cell. b is already placed on a colored cell.

1. Choose **Draw Cells**. Click a cell to color it; click again to clear it. Your stamp may have gaps or separate pieces. At least one cell must be colored.
2. Use **Set n** , **Set a** , and, if wanted, **Set b** to arrange the variables. n may be on an uncolored cell; a and b need separate colored cells. Removing a cell can change which variable locations are available, so check the preview before finishing.
3. For a signed design, check **Two-color mode** and use **Orange +** and **Blue –** to color cells. These tools can also add colored cells to a custom design.
4. Click **Choose Stamp**.

Your custom shape is kept in a saved investigation. It is not added as a permanent new tile in the built-in gallery. Save different designs as separate files, if you want to use them again.

Grids Without Numbers

Hiding the Numbers

Choose **No Values** in the **Grid** menu to hide all cell values. The width of the grid will still be visible as shown in the screenshot below. This mode removes the numerical data and focuses your attention on the geometric relationship between the cells in the shape. You will need to generalize for all stamp locations. Since stamping in one place is no different than another, only one location is shown. Likewise, the **Conjectures** table will only show one line, and it won't show any data – it just provides the opportunity to enter an expression and then gives feedback on whether or not that expression works. As before, all expressions are in terms of n and will be the same as they would be if values were shown. For example, the screenshot that follows shows the Vertical 2 stamp with a **Width** of 9 and **Count by** of 1. For this situation, $n + 9$ is the correct expression regardless of whether the values are showing or not.

Number grid

Grid **Width: 9** **Count by 1**

No Values ▾ 5 12 1 12

☐ Cycle shades ☐ Use variable width w ☐ Use variable count by c

← 9 →

Your stamp
Vertical 2 - 2 colored cells

Conjectures Add Column

	Investigate	Your expression
n	a ▾	$n+9$
n	Not shown	✓ That works!

1. a: ✓ That works!
Your expression should work wherever the stamp is placed.

You may have up to three columns at a time. You may use them for different values or to compare different expressions for the same value.

Solving for All Widths at Once

Check **Use variable width w** below the **Width** slider to generalize all problems to all possible widths, w . When this checkbox is checked, the **Grid** menu will switch to **No Values** and the width slider is disabled. The width is now w , representing any and all possibilities, and expressions need to incorporate w , if it affects the values (which it most likely will, if cells are on more than one row). w is available in the expression editor.

The grid now appears as shown here at right. The ellipsis notation (“...”) indicates an unspecified number of intervening columns. As with the regular **No Values** mode, the shape can be stamped only once, the location doesn’t matter, and there will be only one row in the **Conjectures** table.

Grid **Width: w**

No Values ▾ 5 12 1 12

☒ Use variable width w

The width is w ; only part of the grid is shown.

← w →

This mode provides the opportunity for the next level in abstract thinking as you consider how the values in a shape’s cells will change for all possible widths at once. At right is a sample solution: a is three rows of w cells above, and one column to the left of, n as expressed in the formula $n - 3w - 1$.

Number grid

Grid **Width: w** **Count by 1**

No Values ▾ 5 12 1 12

☐ Cycle shades ☒ Use variable width w ☐ Use variable count by c

The width is w ; only part of the grid is shown.

← w →

Your stamp
Custom stamp - 11 colored cells
The uncolored n cell does not count toward Sum or Product.

Conjectures Test Values... Add Column

	Investigate	Your expression
n	a ▾	$n-3w-1$
n	Not shown	✓ That works!

1. a: ✓ That works!
Your expression should work wherever the stamp is placed.

You may have up to three columns at a time. You may use them for different values or to compare different expressions for the same value.

Find the pattern.

Generalizing for Different Count by Values

Check **Use variable Count by c** below the **Count by** slider to generalize all problems for all skip counting values. Once checked, the program switches to No Values, disables the **Count by** slider, and lets you use c in expressions. The value c is the amount added at each step across the grid. n is still the value at the stamp’s n cell, so the cell to its right is c greater and has the value $n + c$. If the row width is 8, then each row has 8 changes of c , so the cell below n has value $n + 8c$.

Using w and c Together

If both variable options are checked, moving right adds c . Moving down adds wc . Moving diagonally down and right adds $wc + c$. For the simple Vertical 2 shape shown at right, the three column options become: $a = n + wc$ Sum = $2n + wc$ Product = $n(n + wc)$

Grid

Width: w

Count by c

No Values ▾

5 12

1 12

☒ Use variable width w
☒ Use variable count by c

Both the **Width** and the **Count by** amount can be variables.



Your stamp

Vertical 2 · 2 colored cells

Unchecking c returns the **Grid** menu to **Counting**, if w is also unchecked. If w remains enabled, the grid stays in **No Values** mode and the ordinary **Count by** slider becomes available again. Unchecking either variable clears expressions that use that now-unavailable variable. **Undo** restores the previous setting and expressions.

Testing Values and Reading Feedback

Whenever w or c is enabled, the **Test values...** button appears beside the **Add Column** button above the Conjectures table. This tool allows you to try concrete values for n , w , and c , connecting your general expression to particular numerical examples. This option is helpful for debugging expressions – it gives feedback comparing correct values to the ones your expressions are generating.

Test Values

Choose numbers to test in your expression. Your grid is not affected by these choices.

Anchor

Width

Count by

n

w

c

17

11

3

Test

Comparison	Actual value	Your expression
1. a	50	50
2. Product	850	322

Close

1. Open **Test values...** and enter a value for n . Set w , c , or both depending on which options are enabled. A setting that is fixed by a slider is shown but cannot be edited here.
2. Click **Test**. For every table column, compare the actual value with the result of your expression. In the example above, $n + wc$ becomes $17 + 11 \times 3 = 50$.
3. Try another set of numbers. Change just one value at a time if you want to see which part of the expression responds. Close the panel when you are ready to continue; the grid itself is not affected by these choices.

Use integers for these tests. n can be negative, zero, or positive. The **Count by** amount is positive, and the width must be at least 5 and wide enough for the stamp. The panel reminds you of the allowed ranges, if an entry is outside them.

What the Feedback Means

In No Values mode, “That works!” means the program’s numerical checks agree with your expression. “That expression doesn’t match” means it found a disagreement. When an expression is not correct, the **Show a Counterexample** button will pick random values that show a mismatch between the correct value and the one generated by your expression.

A counterexample can help you locate a missing step, sign, or order of operations mistake. If the program cannot check an expression, it gives a message such as a reminder to look for division by zero. Seek clarity on how the positions and colors of the cells explain each part of your expression.

Saving, Opening, and Printing Your work

Save and Open

The **Save** button, in the upper right corner, downloads a .stamps file containing all of your current investigation: the current settings, shape stamps, and **Conjectures** table entries. The file will download with the current date in its file name. You can rename it with a descriptive name of your shape. Be sure to leave the “.stamps” file suffix in place, so it can be reopened. Because *Stamp It!* is a browser-based program, files can only be reopened from within the program (and not by clicking on the files).

Use **Open** to choose a saved .stamps file. The program asks if you want to save your current work before replacing it. Choose **Save current & open** if you want to keep that work first, **Open** to replace it, or **Cancel** to leave it alone.

Save PDF and Print

Save PDF creates a landscape report with your grid, stamp, settings, and conjectures. For the grid, choose **Visible rows** for the portion you are viewing, or **All stamped regions** to include the areas where you stamped. The numbered-grid report includes all table examples, even if some are off screen, and follows the current n sorting order.

In No Values mode, the report shows the symbolic investigation and its expressions. The selected variable settings appear in the report. Click **Download PDF**, then open the downloaded file to print or share it. A PDF is for reading; use the .stamps file if you want someone to edit the investigation. PDF files are formatted for neat printing with helpful page breaks (rather than trying to print directly from a browser).

Undo

Undo reverses recent grid actions, such as stamping, adding rows, and changing grid settings. It is not a complete edit history for every tool. Use **Cancel** while editing an expression or choosing a stamp if you want to discard that draft. Changing the stamp starts a new investigation and clears its previous examples, expressions, and Undo history; opening a file also starts a fresh Undo history.

Questions for Investigations

- Can you explain why your rule works for every allowed stamp location without relying on numerical examples?
- Can you write two equivalent expressions for the same quantity and explain how each reflects the stamp’s arrangement?

- Can a stamp cover more than one row but have a sum that does not depend on the grid width?
- How does the sum change when the stamp moves one cell to the right or one row down?
- How does choosing a different cell as the anchor n change your expression for the same stamp?
- What relationship(s) are there between the number of cells in a shape and the expression for its sum?
For its product?
- Which changes to the stamp leave its sum unchanged?
- Can you design a two-color stamp whose sum stays constant wherever it is placed?
- Can two different stamps have the same sum expression for every allowed grid width and counting step?

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