

CUT & GLUE SORT

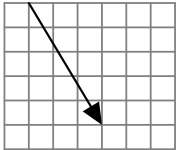


TRANSLATIONS IN THE COORDINATE PLANE

Which Translation — or None?

A rule · its undoing · not a translation at all

FREE

1 The rule that undoes $(x, y) \rightarrow (x - 3, y + 5)$	2 $(x, y) \rightarrow (x + 3, y - x)$	3 Every point moves 5 units up and 3 units left.	4  Every point moves by this arrow.
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Cut & Glue Sort — how to run it

25 minutes, including the cutting

1. **Hand out pages 3 and 4**, one of each per student, and scissors and glue.
2. **Say this once:** *“Turn every piece into an arrow: how far across, how far up. If a piece's arrow matches a row's rule, the piece goes in that row. If the points do not all move by one arrow, it is not a translation at all.”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. The rule and its arrow are printed on page 3 as pictures.
Answers	page 5.

The first two rows are a translation and the translation that undoes it. Each row has a piece in words, an arrow on squared paper, one point and its image, and “the rule that undoes” the other row's rule. A common mistake is to read a piece the wrong way round. A student reads the arrow from its head, or reads the point pair from the image back to the original. Or a student copies the rule inside “the rule that undoes” as it is. Each of these puts the piece in the other row. A student who makes this mistake often has the first two rows swapped, which is easy to see.

The third row is the hardest. Its pieces are not translations, because the shift is not the same for every point. Piece 2 is a rule written in the same form as a translation rule, but its second part subtracts x . Many students believe that any rule written in this form is a translation. Almost everybody is fooled by it at first. Piece 11 describes a similar motion in words. Piece 5 shows two points that one motion moves by different amounts. Piece 8 shows two different arrows for one motion. Without this row, students could finish the sort just by elimination.

Guessing does not work. A student who sorts by simple clues, such as a “+ 3” or the word “right”, gets at most six of the twelve pieces right.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
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Which translation — or none?

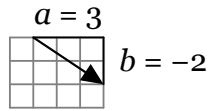
Rules, arrows and points

Name _____

Period _____

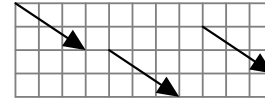
Date _____

Cut out the twelve pieces on the next page. Each one describes a way of moving the points of the plane. **Decide which rule fits it, or whether neither does.** Glue each into that row. **A translation moves every point by the same arrow: across by the first number, up by the second.**



$$(x, y) \rightarrow (x + 3, y - 2)$$

a is across: right +, left - · b is up: up +, down -



the same rule, drawn anywhere

every point of the plane moves by the same arrow

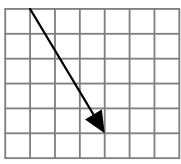
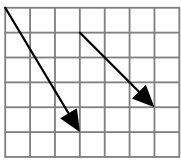
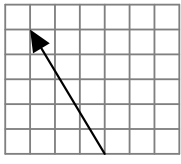
$(x, y) \rightarrow (x + 3, y - 5)$ — one translation

$(x, y) \rightarrow (x - 3, y + 5)$ — another translation

Not a translation — the shift is not the same for every point, so no one arrow describes it

The twelve pieces

Cut along the dotted lines

1	2	3	4
The rule that undoes $(x, y) \rightarrow (x - 3, y + 5)$	$(x, y) \rightarrow (x + 3, y - x)$	Every point moves 5 units up and 3 units left.	 Every point moves by this arrow.
5	6	7	8
One motion carries (0, 0) to (3, -5), and (2, 1) to (7, -4).	A translation carries (1, -1) to (-2, 4).	Every point moves 5 units down and 3 units right.	 One motion moves two points by these two arrows.
9	10	11	12
The rule that undoes $(x, y) \rightarrow (x + 3, y - 5)$	A translation carries (-2, 4) to (1, -1).	Every point moves 5 units down, and right by as many units as its own y -coordinate.	 Every point moves by this arrow.



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Cut & Glue Sort — answers

For the teacher

$(x, y) \rightarrow (x + 3, y - 5)$	1 — To undo a shift, use the same shift the other way.	4 — The arrow goes +3 across and -5 up.	7 — It moves every point right 3 and down 5.	10 — From $(-2, 4)$ to $(1, -1)$ is +3 across and -5 up.
$(x, y) \rightarrow (x - 3, y + 5)$	3 — It moves every point left 3 and up 5.	6 — From $(1, -1)$ to $(-2, 4)$ is -3 across and +5 up.	9 — To undo a shift, use the same shift the other way.	12 — The arrow goes -3 across and +5 up.
Not a translation	2 — The second part subtracts x , so a point farther right moves farther down.	5 — The first point moves 3 across and the second moves 5.	8 — One arrow goes +3 across and -5 up, the other +3 across and -3 up. A translation moves every point by the same arrow.	11 — A point higher up moves farther right.

Every row holds four pieces. Each row has at least one piece in words, one drawing, and one piece with points or a rule. To sort a piece, find the one shift that moves every point. Put the piece in the row whose rule gives that shift. If no single shift works for every point, the piece goes in the third row.