

CUT & GLUE SORT

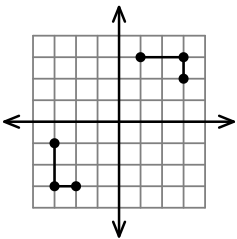


REFLECTIONS IN THE COORDINATE PLANE

Which Mirror — or None?

$y = x$ · $y = -x$ · no reflection does this

FREE

1 A reflection carries $(-3, 5)$ to $(5, -3)$.	2 A reflection with the rule $(x, y) \rightarrow (-x, -y)$	3  A reflection carries one L onto the other.	4 A reflection leaves $(0, 0)$ where it is, and moves every other point.
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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:** *“For every piece, find the mirror: which points stay where they are, and where one point goes. If one mirror cannot do everything the piece says, it goes in the last row.”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. Page 3 shows the four mirror lines as pictures, with all their names and the points each one leaves where they are. It does not show their rules.
Answers	page 5.

The first two rows are the two slanted mirror lines, $y = x$ and $y = -x$. Students find these the hardest, so they are the main work of the lesson. Each of these rows gets one piece of each kind: a rule in letters, one point and its image, two points it leaves where they are, and an L and its image on squared paper with no mirror drawn. A student who mixes up the two lines will glue a whole row into the other one. On a piece with one point and its image, where the minus signs sit does not tell you the mirror. The line $y = x$ swaps the two coordinates. The line $y = -x$ swaps them and also changes both signs.

The last row holds what no reflection does. One rule changes both signs: that is a half turn about the origin, not a reflection. One L is slid, not flipped, into the place where $y = x$ would put it. One piece gives two pairs of points that need two different mirrors. Many students find the mirror from the first pair and then use it for everything. One piece leaves only one point where it is, but a reflection leaves a whole line of points where they are. No piece uses the x -axis or the y -axis, because such a piece would fit no row.

Guessing does not work. A student who sorts by the look of a piece, such as its minus signs or its length, 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 mirror — or none?

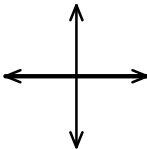
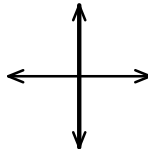
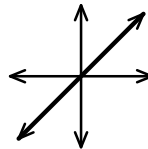
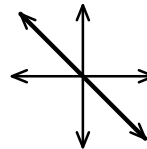
Rules, points and figures

Name _____

Period _____

Date _____

Cut out the twelve pieces on the next page. Each one says something about a reflection. **Decide which mirror line does it, or whether none does, and glue it into that row.** On a drawing, the long arm goes to the long arm and the short arm to the short arm.

			
the x-axis · $y = 0$ <i>the horizontal axis · $(x, 0)$ stays put</i>	the y-axis · $x = 0$ <i>the vertical axis · $(0, y)$ stays put</i>	$y = x$ <i>(a, a) stays put</i>	$y = -x$ <i>$(a, -a)$ stays put</i>

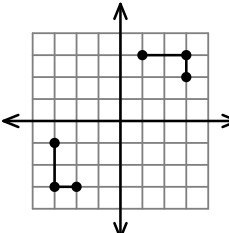
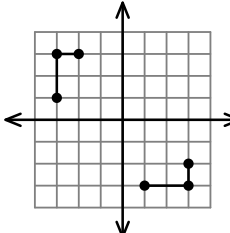
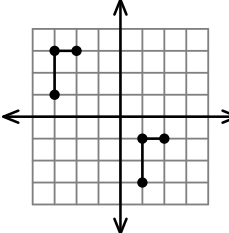
The reflection in the line $y = x$

The reflection in the line $y = -x$

No reflection does this — no one mirror does all that the piece says

The twelve pieces

Cut along the dotted lines

1 A reflection carries $(-3, 5)$ to $(5, -3)$.	2 A reflection with the rule $(x, y) \rightarrow (-x, -y)$	3  A reflection carries one L onto the other.	4 A reflection leaves $(0, 0)$ where it is, and moves every other point.
5 A reflection with the rule $(x, y) \rightarrow (-y, -x)$	6  A reflection carries one L onto the other.	7 A reflection leaves $(3, -3)$ and $(-1, 1)$ where they are.	8 A reflection with the rule $(x, y) \rightarrow (y, x)$
9 A reflection carries $(1, 4)$ to $(4, 1)$, and $(-4, 1)$ to $(-1, 4)$.	10 A reflection leaves $(-2, -2)$ and $(4, 4)$ where they are.	11  A reflection carries one L onto the other.	12 A reflection carries $(-5, 2)$ to $(-2, 5)$.



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Cut & Glue Sort — answers

For the teacher

The reflection in the line $y = x$	1. The midpoint (1, 1) is on $y = x$.	6. Every corner goes to its image in $y = x$. For example, the bend $(-3, 3)$ goes to $(3, -3)$.	8. This is the rule of the reflection in $y = x$.	10. Both points are on $y = x$, and a reflection leaves every point of its mirror where it is.
The reflection in the line $y = -x$	3. Every corner goes to its image in $y = -x$. For example, the bend $(-3, -3)$ goes to $(3, 3)$.	5. This is the rule of the reflection in $y = -x$.	7. Both points are on $y = -x$, and a reflection leaves every point of its mirror where it is.	12. The midpoint $(-3.5, 3.5)$ is on $y = -x$.
No reflection does this	2. Both signs change and the numbers do not swap. This is a half turn about the origin, not a reflection.	4. Only one point stays where it is. A reflection leaves a whole line of points where they are.	9. The first pair is a reflection in $y = x$. The second pair is a reflection in $y = -x$.	11. The end of the long arm, $(-3, 1)$ to $(1, -3)$, fits $y = x$, but the bend does not. The L is slid, not flipped.

Every row holds four pieces. To place a piece, find the one reflection that carries its first point to its image. Then check whether that reflection does everything else the piece says. If it does not, the piece goes in the last row. Every piece fits exactly one row.

A check students can use on their own. The midpoint of a point and its image must lie on the mirror. In the first row, the midpoint's two numbers are equal. In the second row, they are opposites.