

MYSTERY PICTURE

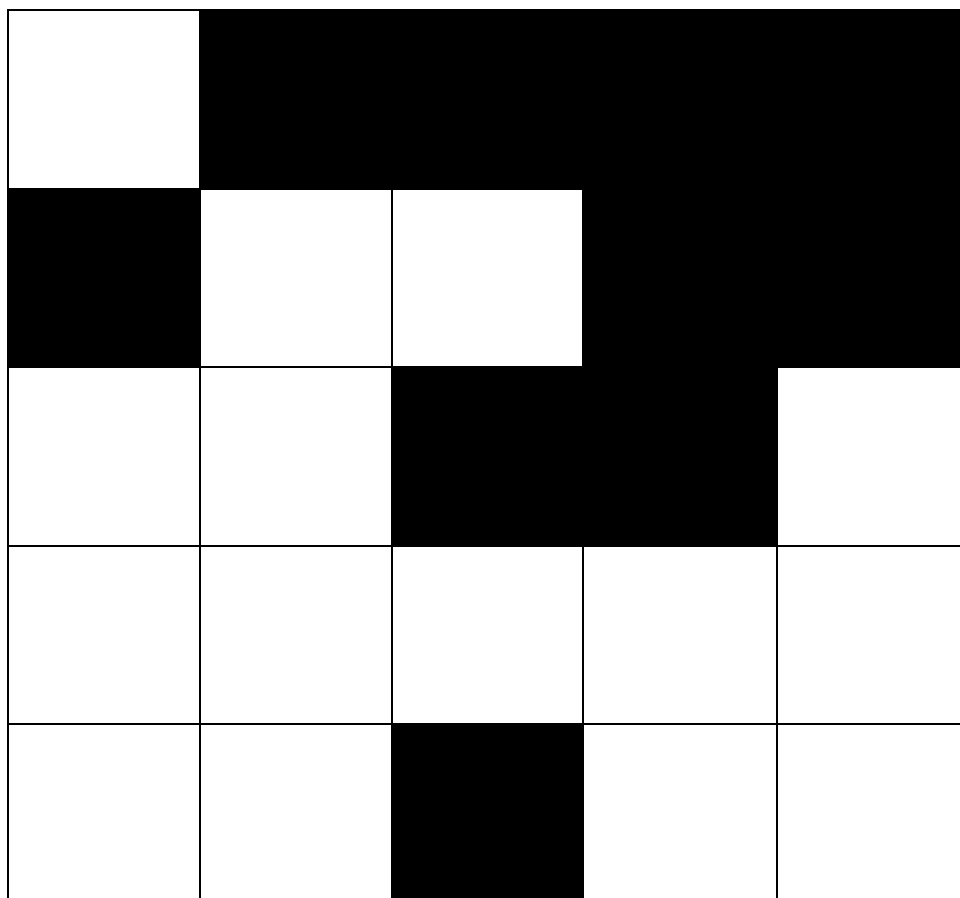


ROTATIONS IN THE COORDINATE PLANE

Rotations: Did It Land in the Right Place?

25 points, 25 turns · a sign and a swap, never an addition · wrong answers show in the picture

FREE



1. **Hand out page 3**, one per student. Students need only a pencil.
2. **Say this once:** *“Each square has its own turn. Read which way, how far, and about which center before you start. Is the point shown the correct image? If yes, fill the square with slanted lines. If no, leave it white.”*
3. **When you finish, look at the picture.** If part of it is missing, or one square does not fit, check that square again.

Student sheet	page 3, one per student. The four turns and all their names are printed on it as pictures. Their rules are not printed.
Answers	page 4 — the finished picture and the reason for every square.

Ten squares are filled and fifteen are white. The finished picture is a question mark. Each white square shows a common mistake with these rules. In four, the turn goes the wrong way. In three, the right numbers are written in the wrong order. In three, the half turn is mixed up with the reflection in $y = -x$, which also swaps the numbers. In two, the signs change without the swap, or the numbers swap without the signs. In two, the origin's rule is used for a turn about another center. In one, the center of the turn moves. One filled square is the origin turned about itself, and it stays where it is. Students often forget that the center of a turn does not move.

The turns are named nine different ways, so students must read the direction every time. Both the three-quarter turn counterclockwise and the 270° turn clockwise are on the sheet. Every filled square turns about the origin. The squares that turn about another center are all white.

Half a method is not enough. A student who checks only whether the numbers swap gets five squares wrong. A student who checks only the signs gets five wrong. **Guessing does not work either.** Every simple guessing rule, such as filling every square where both signs change, gets at least eight squares wrong.



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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Mystery Picture

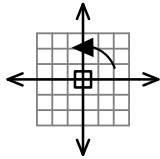
Did it land in the right place?

Name _____

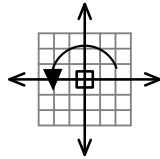
Period _____

Date _____

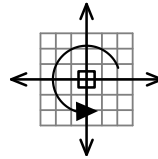
Each square shows a point turned about a center. Is the point shown the correct image? If yes, fill the square with slanted lines. If no, leave it white. Each square has its own turn: which way, how far, and about which center. A point and its image are always the same distance from the center. **When you finish, look at the picture. If part of it is missing, or one square does not fit, that square is wrong.**



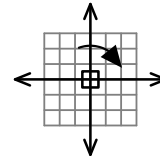
quarter turn counterclockwise
 $+90^\circ$ · the center stays put



half turn · 180° , either way
 also: the point reflection in the center



three-quarter turn counterclockwise
 $+270^\circ$ · the same turn as -90°



quarter turn clockwise
 -90° · the same turn as $+270^\circ$

1 $(-3, 5)$ a quarter turn counterclockwise about the origin $\rightarrow (5, 3)$	2 $(4, -1)$ a quarter turn clockwise about the origin $\rightarrow (-1, -4)$	3 $(-6, -2)$ a half turn about the origin $\rightarrow (6, 2)$	4 $(2, 7)$ a three-quarter turn counterclockwise about the origin $\rightarrow (7, -2)$	5 $(0, 0)$ a quarter turn counterclockwise about the origin $\rightarrow (0, 0)$
6 $(-5, -1)$ a turn of 270° clockwise about the origin $\rightarrow (1, -5)$	7 $(3, -7)$ a turn of 180° about the origin $\rightarrow (7, -3)$	8 $(-1, 6)$ a turn of -90° about the origin $\rightarrow (1, 6)$	9 $(6, 3)$ a turn of 90° counterclockwise about the origin $\rightarrow (-3, 6)$	10 $(-2, -7)$ the point reflection in the origin $\rightarrow (2, 7)$
11 $(5, -4)$ a three-quarter turn counterclockwise about the origin $\rightarrow (4, 5)$	12 $(-7, 1)$ a quarter turn counterclockwise about the origin $\rightarrow (-7, -1)$	13 $(1, -5)$ a quarter turn clockwise about the origin $\rightarrow (-5, -1)$	14 $(-4, 3)$ a turn of 180° about the origin $\rightarrow (4, -3)$	15 $(2, -6)$ a half turn about the origin $\rightarrow (6, -2)$
16 $(-6, -5)$ a quarter turn clockwise about the origin $\rightarrow (5, -6)$	17 $(3, 4)$ a turn of 90° counterclockwise about the origin $\rightarrow (4, 3)$	18 $(5, 2)$ a half turn about $K(2, 1)$ $\rightarrow (-5, -2)$	19 $(1, -3)$ a quarter turn counterclockwise about $K(1, -3)$ $\rightarrow (3, 1)$	20 $(-1, -3)$ a turn of 270° clockwise about the origin $\rightarrow (-3, 1)$
21 $(7, -2)$ a turn of -90° about the origin $\rightarrow (-7, -2)$	22 $(-3, -1)$ a three-quarter turn counterclockwise about the origin $\rightarrow (-3, 1)$	23 $(4, -3)$ a quarter turn counterclockwise about the origin $\rightarrow (3, 4)$	24 $(-2, 5)$ the point reflection in the origin $\rightarrow (-5, 2)$	25 $(6, -1)$ a half turn about $M(-1, 2)$ $\rightarrow (-6, 1)$

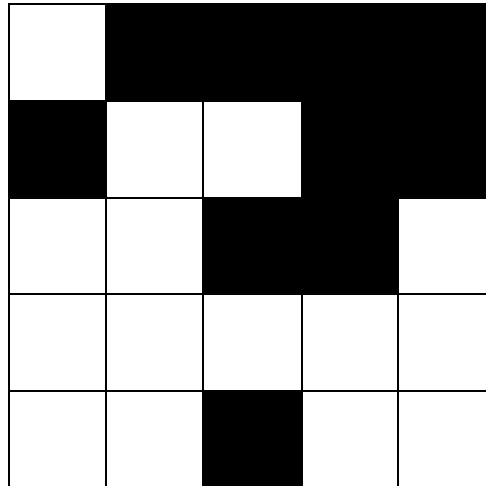


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Mystery Picture — answers

For the teacher

The finished picture is a **question mark**. The table reads left to right, the same way as the sheet. Each square gives the correct image of the point. A square is filled when the point shown is that image. A white square also names the mistake that gives the point shown.



1–5	white: the image is $(-5, -3)$. Here the point turned the wrong way.	FILL: the image is $(-1, -4)$.	FILL: the image is $(6, 2)$.	FILL: the image is $(7, -2)$.	FILL: the image is $(0, 0)$.
6–10	FILL: the image is $(1, -5)$.	white: the image is $(-3, 7)$. Here the rule used is the reflection in $y = -x$, not the half turn.	white: the image is $(6, 1)$. Here the two numbers are in the wrong order.	FILL: the image is $(-3, 6)$.	FILL: the image is $(2, 7)$.
11–15	white: the image is $(-4, -5)$. Here the point turned the wrong way.	white: the image is $(-1, -7)$. Here the two numbers are in the wrong order.	FILL: the image is $(-5, -1)$.	FILL: the image is $(4, -3)$.	white: the image is $(-2, 6)$. Here the rule used is the reflection in $y = -x$, not the half turn.
16–20	white: the image is $(-5, 6)$. Here the point turned the wrong way.	white: the image is $(-4, 3)$. Here the numbers swapped, but no sign changed.	white: the image is $(-1, 0)$. Here the origin's rule was used about another center.	white: the image is $(1, -3)$. Here the center moved, but a center never moves.	white: the image is $(3, -1)$. Here the point turned the wrong way.
21–25	white: the image is $(-2, -7)$. Here the two numbers are in the wrong order.	white: the image is $(-1, 3)$. Here the signs changed, but the numbers did not swap.	FILL: the image is $(3, 4)$.	white: the image is $(2, -5)$. Here the rule used is the reflection in $y = -x$, not the half turn.	white: the image is $(-8, 5)$. Here the origin's rule was used about another center.

The rules, for turns about the origin only. A quarter turn counterclockwise (also called 90° counterclockwise, or 270° clockwise) is $(x, y) \rightarrow (-y, x)$. A quarter turn clockwise (also called -90° , or a three-quarter turn counterclockwise) is $(x, y) \rightarrow (y, -x)$. A half turn (also called 180° , or the point reflection in the origin) is $(x, y) \rightarrow (-x, -y)$. A half turn about the point (a, b) is $(x, y) \rightarrow (2a - x, 2b - y)$.