

CUT & GLUE SORT



COMPOSITIONS OF RIGID MOTIONS

Carry ABC onto DEF: Right, Backwards, or Missing a Part?

Twelve two-step answers · order and direction · a missing center, line, angle or direction

FREE

1	2	3	4
First, rotate it 180° about $(2, 1)$. Then reflect it in the y -axis.	First, reflect it in the y -axis. Then rotate it 180° .	First, rotate it 180° about $(3, 1)$. Then reflect it in the line $x = 5$.	First, reflect it in the line $y = 1$. Then translate it by $\langle 4, 0 \rangle$.

Cut & Glue Sort — how to run it

25–30 minutes, including the cutting

1. **Hand out pages 3 and 4**, one of each per student, and scissors and glue.
2. **Say this once:** *“Each piece is a student's answer. Do its two motions to triangle ABC, in order. Does ABC land on DEF? If a piece is missing a center, a line or a direction, you cannot do it.”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. The two triangles are drawn on page 3, on a numbered grid.
Answers	page 5.

Each piece is one student's answer, and the three rows are the three ways such an answer is marked. The answer is correct. Or it goes the wrong way, so it carries DEF onto ABC. Or it leaves out a part that a motion needs: the center of a half turn, the direction of a translation, the line of a reflection, or the angle of a rotation. An answer with a missing part cannot be carried out at all. So nobody can check it by doing the motions, and it cannot get the mark.

A wrong-way answer often reads just like a correct one. Every motion in the first two rows is a reflection, a half turn or a translation. A reflection or a half turn undoes itself. So to undo “first S, then T”, you do “first T, then S”. That is why three of the wrong-way pieces are correct pieces with their two sentences swapped. Reading cannot tell them apart. Only doing the motions can. One correct piece is a reflection followed by a slide along the mirror line. That pair gives the same result in either order.

Guessing does not work. Every simple rule that sorts by the words alone, such as by which motion comes first, 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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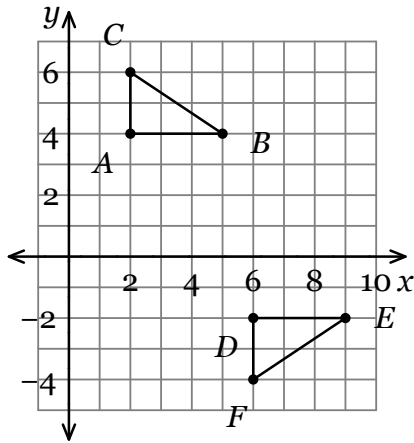
Carry ABC onto DEF

Twelve answers to one question

Name _____

Period _____

Date _____



Twelve students answered this question: **Describe two motions that carry triangle ABC onto triangle DEF.** A goes to D, B goes to E, and C goes to F.

Cut out the twelve pieces on the next page. For each piece, do its two motions to A, B and C, in order. **Where do they land? Then glue the piece into the right row.**

If ABC does not land on DEF, do the same two motions to D, E and F.

Correct: it carries triangle ABC onto triangle DEF.

Wrong: it goes the wrong way. It carries DEF onto ABC.

Wrong: a part is missing, so nobody can do it.

The twelve answers

Cut along the dotted lines

In every piece, “it” means the triangle.

1 First, rotate it 180° about $(2, 1)$. Then reflect it in the y -axis.	2 First, reflect it in the y -axis. Then rotate it 180° .	3 First, rotate it 180° about $(3, 1)$. Then reflect it in the line $x = 5$.	4 First, reflect it in the line $y = 1$. Then translate it by $\langle 4, 0 \rangle$.
5 First, reflect it in the line $x = 5$. Then rotate it 180° about $(3, 1)$.	6 First, translate it 4 units. Then reflect it in the line $y = 1$.	7 First, reflect it in the y -axis. Then rotate it 180° about $(2, 1)$.	8 First, rotate it 180° about $(2, 1)$. Then reflect it in a vertical line.
9 First, translate it by $\langle -4, 0 \rangle$. Then reflect it in the line $y = 1$.	10 First, rotate it 180° about $(2, 1)$. Then reflect it in the line $x = 4$.	11 First, rotate it about $(3, 1)$. Then reflect it in the line $x = 5$.	12 First, reflect it in the line $x = 4$. Then rotate it 180° about $(2, 1)$.



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Cut & Glue Sort — answers

For the teacher

Correct: it carries triangle ABC onto triangle DEF.	3 — The first motion takes A (2, 4) to (4, -2). The second takes it to (6, -2), which is D. B and C land on E and F the same way.	4 — The first motion takes A (2, 4) to (2, -2). The second takes it to (6, -2), which is D. B and C land on E and F the same way.	7 — The first motion takes A (2, 4) to (-2, 4). The second takes it to (6, -2), which is D. B and C land on E and F the same way.	10 — The first motion takes A (2, 4) to (2, -2). The second takes it to (6, -2), which is D. B and C land on E and F the same way.
Wrong: it goes the wrong way. It carries DEF onto ABC.	1 — The two motions take A (2, 4) to (-2, -2), not to D. They take D (6, -2) to (2, 4), which is A.	5 — The two motions take A (2, 4) to (-2, -2), not to D. They take D (6, -2) to (2, 4), which is A.	9 — The two motions take A (2, 4) to (-2, -2), not to D. They take D (6, -2) to (2, 4), which is A.	12 — The two motions take A (2, 4) to (-2, -2), not to D. They take D (6, -2) to (2, 4), which is A.
Wrong: a part is missing, so nobody can do it.	2 — The half turn has no center, so nobody knows where the triangle goes.	6 — The translation says 4 units but not which way, so nobody knows where the triangle goes.	8 — The reflection does not say which vertical line, so nobody knows where the triangle goes.	11 — The rotation has no angle, so nobody knows how far to turn.

For marking students' own answers: the one motion that carries ABC onto DEF sends (x, y) to $(x + 4, 2 - y)$. It is a reflection in the line $y = 1$ and a slide of 4 to the right, done in either order. There are many other correct sequences. To check one, do its two motions to A, B and C and see whether they land on D, E and F.