

CUT & GLUE SORT

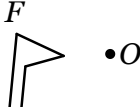


ROTATIONS

Does It Name a Rotation?

One rotation · not a rotation · not enough

FREE

1  Turn F 90° clockwise.	2  Every point of F turns 90° clockwise about O and stays on its own circle.	3  Turn F's pennant 90° clockwise about O, not its pole.	4 Turn F 60° counterclockwise about O, then push every point further out from O.
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1. **Hand out pages 3 and 4**, one of each per student, and scissors and glue.
2. **Say this once:** *“A rotation needs three things: the center, the size of the angle, and the direction. If one is missing, the words do not name one rotation. If the points do not all turn about one center by the same angle, it is not a rotation at all.”*
3. **Every row gets 4.** A row with more or fewer has a piece in the wrong place. (This count is on your page only, not on the student's sheet.)

Student sheets pages 3 and 4, one of each per student.

Answers page 5.

The third row, NOT ENOUGH, is the heart of this lesson. Its pieces (1, 6, 8, 10) each describe a real turn but leave something out. One gives no center, one gives no direction, and one gives no angle. The last one says “about one of its own corners,” but F has five corners, so it could be five different turns. Students leave out the center more often than anything else, and a test answer without it loses points.

The first row shows that a rotation can be named without all three words. “Turn F 180° about O” has no direction word and needs none, because a half turn lands in the same place either way. “The rotation about O that sends P to Q” has no angle and no direction, but P and Q fix both. “A quarter turn clockwise that leaves O where it is” never says “about,” but the center is the one point that does not move. So a student should not just count the three words. The real question is whether the words leave only one possible turn.

The second row holds the mistakes students make most often. Only the pennant (the triangle at the top of flag F) turns, and the pole (the upright bar) stays. The flag turns and is then pushed off its circle. The flag is turned *over*, which is a reflection. Every point moves the same distance around its circle instead of the same angle. Many students measure a turn by how far a point travels, not by the angle at the center.

Guessing does not work. Every simple guessing rule, such as putting a piece in the first row whenever it names a center, an angle and a direction, 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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One rotation, not one, or not enough?

Describing a rotation

Name _____

Period _____

Date _____

Cut out the twelve pieces on the next page. Each one describes a way of moving flag F. **For each piece, decide: is it one rotation, is it not a rotation, or is it not enough to tell?** Glue each into its row. **A rotation is fixed by three things: its center, its angle and its direction. Every point turns about the center by the same angle, the same way, and stays on its own circle.**



center O • angle • direction
OP' is as long as OP: one circle



clockwise
the way a clock's hands go



counterclockwise
the other way round

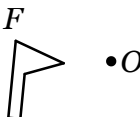
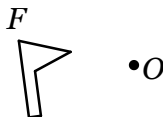
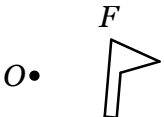
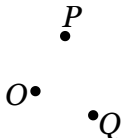
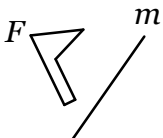
ONE ROTATION — *the words fix the center, the angle and the direction*

NOT A ROTATION — *no one center turns every point by one angle*

NOT ENOUGH — *a rotation, but the words leave it open*

The twelve pieces

Cut along the dotted lines

1  Turn F 90° clockwise.	2  Every point of F turns 90° clockwise about O and stays on its own circle.	3  Turn F's pennant 90° clockwise about O, not its pole.	4 Turn F 60° counterclockwise about O, then push every point further out from O.
5 Turn F 180° about O.	6  Turn F 90° about O.	7  The rotation about O that sends P to Q.	8 Every point of F turns clockwise about O by the same angle.
9  Turn F over, across line m.	10 Turn F a quarter turn counterclockwise about one of its own corners.	11 A quarter turn clockwise that leaves point O where it is.	12 Each point of F moves 3 cm clockwise round its own circle about O.



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Cut & Glue Sort — answers

For the teacher

ONE ROTATION	2 — It names all three things: the center O, the angle 90° and the direction clockwise.	5 — It has no direction word, and it needs none. A half turn lands in the same place either way.	7 — It gives no angle and no direction, but the turn about O from P to Q fixes both.	11 — It never says “about,” but the center of a turn is the one point that does not move. So O is the center.
NOT A ROTATION	3 — Only the pennant, the triangle at the top of F, turns. The pole, the upright bar, stays, so the flag breaks apart. In a rotation every point turns.	4 — The push takes every point off its own circle about O, so the flag comes out a different shape.	9 — Turning F over across a line is a reflection. F comes out facing the other way, and no turn does that.	12 — Every point moves the same distance, not the same angle. 3 cm around a small circle is a bigger turn than around a big one.
NOT ENOUGH	1 — It gives no center. A turn about a different point puts F in a different place.	6 — It gives no direction. 90° clockwise and 90° counterclockwise put F in two different places.	8 — It gives no angle, so F could end up in many different places.	10 — F has five corners, so “one of its own corners” could be five different centers.

How to decide any piece. Ask what the words allow. If they allow only one turn, with one center and one angle, the piece goes in the first row. If they allow a turn but more than one, it goes in the third row. If the motion is not a turn at all, it goes in the second row.