

CUT & GLUE SORT

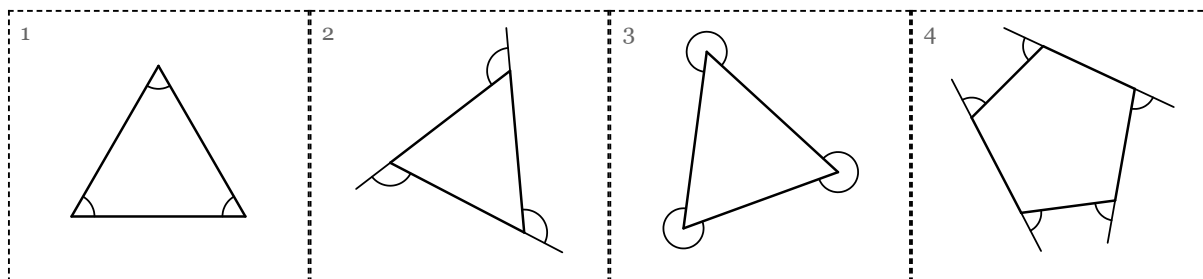


INTERIOR AND EXTERIOR ANGLES OF POLYGONS

Does the Total Grow, or Stay at 360° ?

Interior angles, exterior angles, or neither

FREE



1. **Hand out pages 3 and 4**, one of each per student, with scissors and glue. Nothing else is needed.
2. **Say this once:** *“Do not measure anything. For each piece, look at every corner. Decide what the marked angles add up to: $(n - 2)$ times 180, 360, or neither.”*
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 interior angles, the exterior angles, and an angle that is not an exterior angle, as three small drawings.
Answers	page 5.

The sheet practices one decision: which of the two totals is this? The interior angles of a convex polygon with n sides add up to $(n - 2) \times 180^\circ$, so their total grows as n grows. The exterior angles, one at every corner, always add up to 360° . The second row holds polygons with 3, 5, 6 and 8 sides. Many students expect the exterior total to grow too, and seeing them in one row is the point.

The last row is the most important. The two totals only work for one angle of one kind at every corner. In two of its pieces the arc goes all the way around the outside of each corner. Many students think that is the exterior angle, and it is not. In one piece every corner has two exterior angles, so they add up to 720° . In one piece a corner has no arc. No piece is a quadrilateral: for a quadrilateral both totals are 360° , and they are totals of different angles.

How to see the mistake. A student who puts every piece with arcs inside in the first row and every piece with arcs outside in the second gets eight of the twelve right, and the last row stays empty. Ask that student to point at each corner and say which angle is marked. Other guessing rules place at most six pieces correctly.



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 total do the marked angles make?

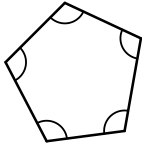
Interior and exterior angles

Name _____

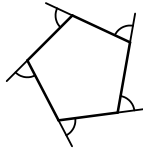
Period _____

Date _____

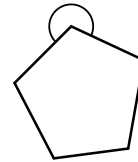
Cut out the twelve pieces on the next page. Each piece shows a polygon with angles marked by arcs. **Do not measure anything. Decide what the marked angles add up to: $(n - 2) \times 180^\circ$, 360° , or neither. Glue the piece in that row.** n is the number of sides.



The **interior** angle at every corner: they add up to $(n - 2) \times 180^\circ$.



One **exterior** angle at every corner: they add up to 360° , for every polygon.



Not an exterior angle: the angle all the way around the outside.

Check every corner. Is there exactly one arc there? Is it the interior angle, or an exterior angle made by a side carried straight on?

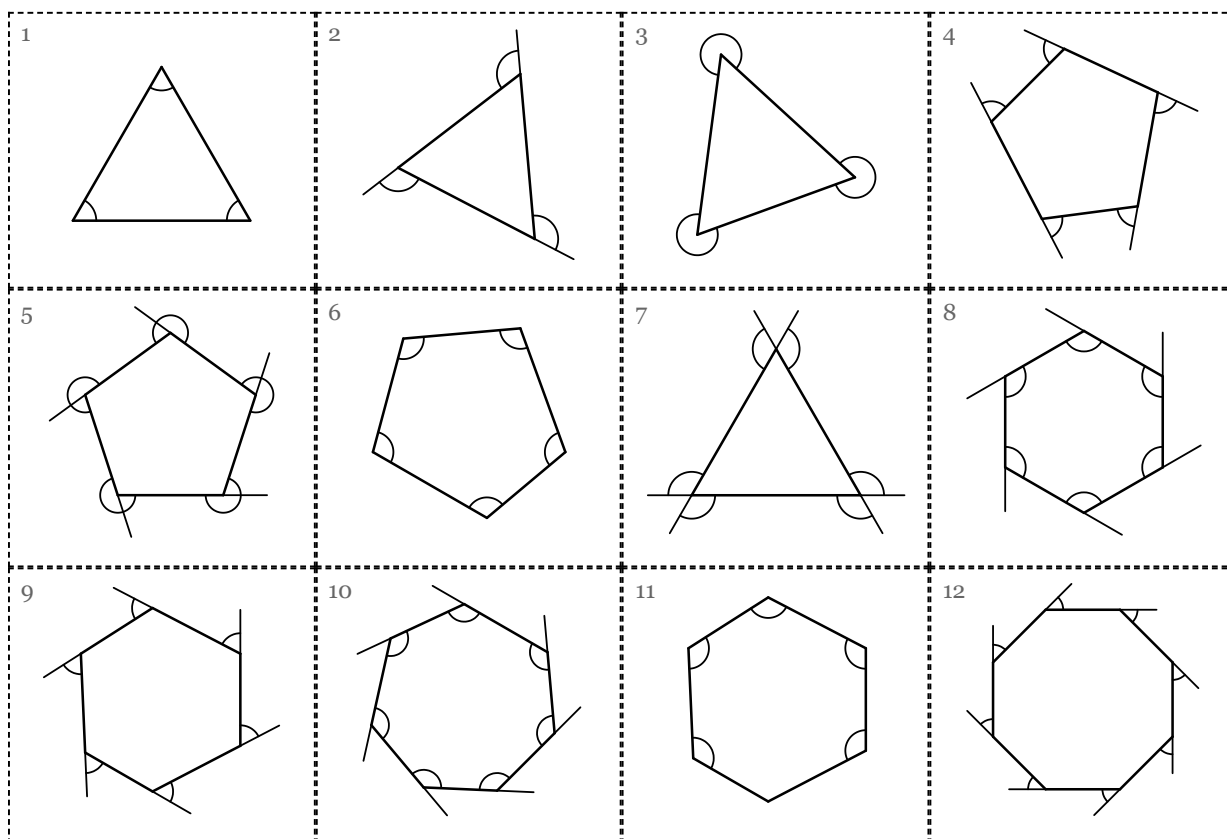
$(n - 2) \times 180^\circ$. The marked angles are the interior angles, one at every corner.

360° . The marked angles are exterior angles, one at every corner.

Neither. The marks are not one interior angle, or one exterior angle, at every corner.

The twelve pieces

Cut along the dotted lines



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Cut & Glue Sort — answers

For the teacher

$(n - 2) \times 180^\circ$	1 — An arc inside at all 3 corners: the interior angles. $(3 - 2) \times 180^\circ = 180^\circ$.	6 — An arc inside at all 5 corners: the interior angles. $(5 - 2) \times 180^\circ = 540^\circ$.	8 — The thin lines carry sides on, but no arc touches them. An arc inside at all 6 corners: the interior angles. $(6 - 2) \times 180^\circ = 720^\circ$.	10 — The thin lines carry sides on, but no arc touches them. An arc inside at all 7 corners: the interior angles. $(7 - 2) \times 180^\circ = 900^\circ$.
360°	2 — At every corner a side is carried straight on, and one exterior angle is marked. The 3 exterior angles add up to 360°.	4 — At every corner one side is carried on, not always the same way. Each arc is still an exterior angle, so the 5 add up to 360°.	9 — At every corner a side is carried straight on, and one exterior angle is marked. The 6 exterior angles add up to 360°.	12 — At every corner a side is carried straight on, and one exterior angle is marked. The 8 exterior angles add up to 360°.
Neither	3 — Each arc goes all the way around the outside of its corner. These are not exterior angles. They add up to 900°.	5 — Each arc goes all the way around the outside of its corner. These are not exterior angles. They add up to 1260°.	7 — Every corner has two exterior angles marked, not one. They add up to 720°, twice 360°.	11 — One corner has no arc. The 5 marked interior angles add up to less than $(6 - 2) \times 180^\circ = 720^\circ$.

Every row holds four pieces. A piece goes in the first row when every corner has one arc, inside the polygon. It goes in the second row when every corner has one arc between a side carried straight on and the other side. It goes in the last row when a corner has no arc, or two arcs, or an arc all the way around the outside.

To check a piece with a student, point at one corner and ask: “How many arcs are here? Is this angle inside the polygon, or between a side carried on and the next side?” Then ask the same at the next corner.