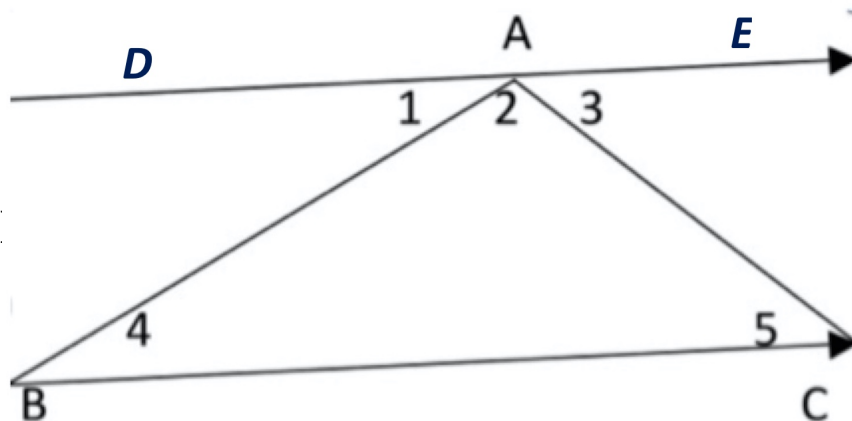


Title: Angle Sum Grades 7 to 9

For any triangle you can construct a line through one of the vertices parallel to the opposite edge. Using what you know about angles and parallel lines prove that the angles of the triangle add up to 180 degrees.



Proof

Line DAE is drawn through vertex A parallel to BC.

$$\angle 4 = \angle 1 \text{ (alternate angles DAE // BC)}$$

$$\angle 5 = \angle 3 \text{ (alternate angles DAE // BC)}$$

$$\angle 1 + \angle 2 + \angle 3 = 180^\circ \text{ (angles on a straight line)}$$

$$\angle ABC + \angle BAC + \angle ACB = 180^\circ \text{ (equal to } \angle 1 + \angle 2 + \angle 3)$$

So the sum of the angles of $\triangle ABC$ is 180° .

Notes for teachers

Why do this activity?

This activity provides a visual prompt for a method of proof that the angles of a triangle add up to 180° suitable for learners in lower secondary school. This proof only requires a little simple reasoning and the knowledge that alternate angles with respect to parallel lines are equal and the angles on a straight line add up to 180° .

After learners have worked from this diagram it could provide a reminder of the proof.

Possible approach

Ideally learners will do activity this before being taught that the angles of a triangle add up to 180° . You could ask the learners to draw their own triangles, to measure the angles carefully and to add up the sum of the three angles. Then ask the totals and make a list on the board. Most will be between 175° and 185° and you would not expect many to be exactly 180° unless the learners already know what the sum should be.

Draw the diagram on the board or give copies to the learners. Tell the learners that **you want them to find out what the angles should add up to and if this will always be the same answer.**

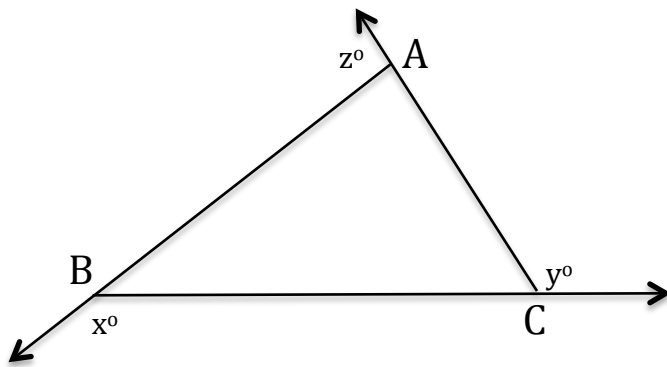
If the learners already know the result then tell them that **you want them to prove** that the angles of a triangle add up to 180° so they cannot assume it is true. Ask the learners to write down all they know about the angles and to try to decide if this is enough to prove the result they want.

After the learners have worked on this activity the teacher can draw out the necessary facts in a question and answer session **building on what the learners have done for themselves.**

Key questions

- Can you see any angles in the diagram that are equal to each other? Why are they equal?
- What do you know about the angles on a straight line?

Possible extension



Explore the path around a triangle. Get 3 learners to make a triangle holding their arms straight out at their sides and holding hands with each other with their hands at A, B and C. Then get another learner to walk around the triangle ending up facing the same way as at the start. Or ask the learners to imagine a small insect crawling around starting at A and facing along AB, then turning through angle x° at B to go along BC, turning through y° at C to go along CA and finally turning through z° at A to face the direction it started in. What is the total turn?

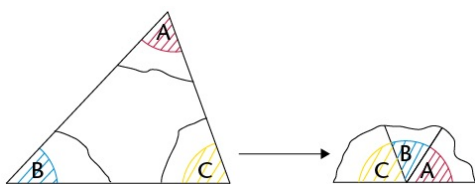
When the class agree that the total turn is one whole revolution or 360° , introduce the terminology 'exterior angles of a triangle' and the fact that they have discovered that the exterior angles of a triangle add up to 360° .

At each vertex there is an exterior and an interior angle adding up to 180° (2 right angles). The sum of all the exterior and interior angles is therefore 3 times 180° (6 right angles). The sum of the exterior angles is 360° (4 right angles) and the sum of the interior angles is 180° (2 right angles).

Also see <https://aiminghigh.aimssec.ac.za/grades-9-to-12-tri-fold/>

Possible support

Drawing triangles, carefully measuring the angles and adding them up is a good preparatory activity. Learners may get totals not even close to 180° revealing that the learner does not know how to use a protractor or does not understand angles very well. This needs to be remedied.



Another demonstration, NOT a proof, is done by cutting out a triangle, tearing the corners off and arranging the three angles of the triangle together as shown. The angles appear to lie on a straight line, therefore adding up to 180° .