re(Solve) MATHS BY INQUIRY

Trapezium Pieces

Y4

Summary of learning goals

- To classify and name two-dimensional (2D) shapes (particularly quadrilaterals) based on their properties.

Australian Curriculum: Mathematics (Year 4)

ACMMG088: Compare and describe two-dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies.

Summary of lessons

Who is this sequence for?

- For students who are familiar with common two-dimensional (2D) shapes. Students should be able to use the properties of a shape to identify and name quadrilaterals, including special groups of quadrilaterals.
- Students should be familiar with the specific shape properties of parallel lines, sides of equal length and right angles.
- Students must be able to recognise any three-sided polygon as a triangle and any five-sided polygon as a pentagon.

Lesson 1: Trapezium Pieces

Students look at the different shapes that can be formed by cutting a trapezium in two with one straight line. Students are asked to classify and name the shapes that are made, and to justify their classifications based on the definitions and properties of shapes.

reSolve: Mathematics by Inquiry is funded by the Australian Government and is managed by the Australian Academy of Science.

Australian Academy of Science

Reflection on this sequence

Rationale

Shapes are named according to their properties. Often students can name shapes based on recognition but are unable to accurately describe their properties. It is important that students define shapes in terms of their specific properties. For example, a rectangle is defined as a quadrilateral that has four right angles. This means that a square is a special type of rectangle. It also means a quadrilateral with four right angles is a rectangle regardless of its orientation.

Students should be presented with typical and non-typical versions of shapes. They should also be challenged to reason why shapes are not part of a specific shape family. This task presents students with typical and non-typical forms of shapes and asks them to use the properties of the shapes to name them.

reSolve mathematics is purposeful

- This task builds students' understanding of geometry. They are asked to reason mathematically about properties and attributes so as to name shapes.

reSolve tasks are inclusive and challenging

- This task has a low floor and a high ceiling. Students can access the task by simply dividing a common shape into two parts with a straight line. Simple reasoning can be used to name and describe shapes.
- Key questions about the conditions under which certain shapes are made are provided to challenge students' thinking and to promote deeper inquiry.

reSolve classrooms have a knowledge-building culture

- Students are challenged to justify that a name given to a shape is correct. Collectively, the class builds an accurate definition for shapes based on the properties that are exhibited.

LESSON 1

reSolve MATHS BY INQUIRY Trapezium Pieces

Trapezium Pieces

Y4

About this lesson

Students look at the different shapes that can be formed by cutting a trapezium in two with one straight line. Students are asked to classify and name the shapes that are made, and to justify their classifications based on the definitions and properties of shapes.

Australian Curriculum: Mathematics (Year 4)

ACMMG088: Compare and describe two-dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies.

Mathematical purpose

- Students learn to classify and name two-dimensional (2D) shapes (particularly quadrilaterals) based on their properties. Students will develop language related to the properties of shapes.

Learning intention

- To learn to classify and name 2D shapes based on their properties.

Time

One to two lessons of approximately 1 hour.

Vocabulary

- adjacent
- opposite
- parallel

Resources

- reSolve PowerPoint *1a Trapezium Pictures*
- reSolve PDF *1b Trapezium Pieces Template* (one printed copy per student)

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Teacher background information

The Australian Curriculum: Mathematics defines a *trapezium* in the following way: A trapezium is a quadrilateral with one pair of opposite sides parallel.
Based on this definition, the following shapes are all classified as trapeziums:

In the first trapezium pictured, the base angles are equal and the top angles are also equal. This means that the opposite non-parallel sides are equal in length. This trapezium can be created by chopping the top off an isosceles triangle, and so it is called an *isosceles trapezium*. This is the typical trapezium shown to students. It is important that students are familiar with all trapeziums, based on the definition given in the Australian Curriculum. This lesson focuses on using non-typical as well as typical trapeziums.

Other definitions of shapes in the Australian Curriculum that are important for this lesson are listed below (adapted from the ACM).

parallelogram	A parallelogram is a quadrilateral whose opposite sides are parallel.
rhombus	A rhombus is a quadrilateral with all sides equal.
rectangle	A rectangle is a quadrilateral in which all angles are right angles.
square	A square is a regular quadrilateral. It has all the properties of a rectangle, and all the properties of a rhombus.

What shapes can you make?

Show the students the pictures provided in the reSolve PowerPoint resource *1a Trapezium Pictures*. Ask them to name each shape and justify that they are all trapeziums (see Teacher background information for the definition of a trapezium). This exercise assists in establishing a class definition of trapeziums as a shape with one set of **parallel** sides.

Pose the question: *What shapes can you make when you cut a trapezium in two with one straight cut?*

Resources: Provide students with the sheets of different trapeziums provided in the reSolve PDF resource *1b Trapezium Pieces Template*.

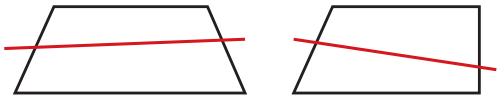
Students divide the trapezium into two shapes using a straight line, either by drawing a line or cutting the shape into two parts. Encourage students to work with a variety of different trapeziums to help create generalisations.

Naming shapes

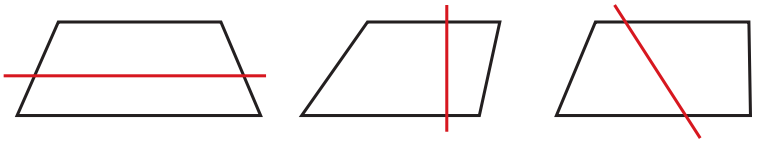
Ask students to organise and record their results. They should record the position of their cuts and the shapes that were made from each cut. Introduce the terms **opposite** and **adjacent** sides to help students explain the position of their cuts.

Possible student response:

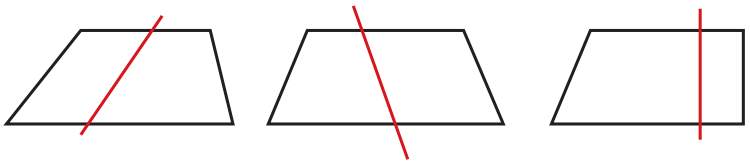
- Cutting between opposite sides creates two quadrilaterals. Some of these quadrilaterals have specific names.



Each shape can be cut into two quadrilaterals.

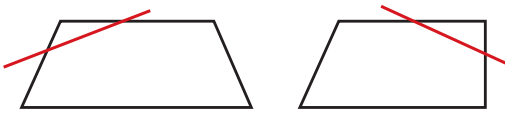


Each shape can be cut into two trapeziums

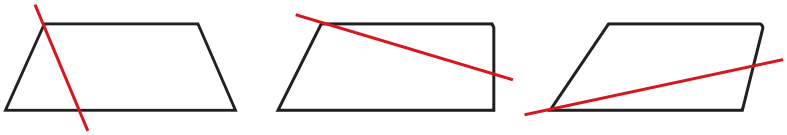


Each shape can be cut into a trapezium and a parallelogram. In the second example, the parallelogram is also called a rhombus. In the third, the parallelogram is also called a rectangle.

- Cutting between adjacent sides creates a triangle and a pentagon.

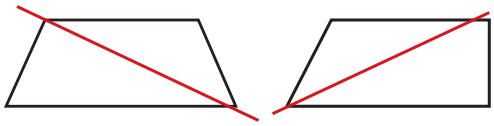


- Cutting from a corner to an opposite side creates a triangle and a quadrilateral.



In the first example, the quadrilateral is also called a parallelogram.

- Cutting between opposite corners creates two triangles.



Questioning to direct the investigation and challenge students' thinking and reasoning

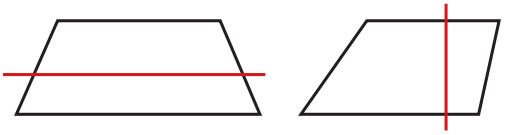
- *Describe the shapes that you have made. How do you know that the shapes are ...?*
  - ◊ The focus of discussion should be on the properties of the shapes and the ways in which the properties allow us to classify and name shapes.
- *What sort of trapezium is needed to make a rectangle? How should you cut it?*
  - ◊ To make a rectangle you need to use a trapezium that has two adjacent right angles. The trapezium should be cut at right angles to the parallel sides.
- *How should you cut the trapezium to make a parallelogram?*
  - ◊ The cut must be parallel to one of the sloping sides. Creating a parallelogram will always create a trapezium or triangle as the other shape.
- *Can you make two triangles? How many ways can you make two triangles?*
  - ◊ It is only possible to make two triangles by joining opposite corners. You can do this in two ways.

Reflection

Have some students present their work, showing the types of cuts and the different shapes found.

Questioning to direct the reflection

- *How can you ensure you make two smaller trapeziums when you cut the original trapezium in two?*
  - ◊ The cut must maintain one set of opposite sides parallel. This is done by a straight cut parallel to the opposite parallel sides (as in the first shape shown at right) or making a cut from one parallel side to another that is not parallel to either of the other two sides of the original trapezium (as in the second shape shown).



- *How can you ensure you make a trapezium and a parallelogram or a triangle and a parallelogram when you cut the original trapezium in two?*
  - ◊ To make a trapezium and a parallelogram, the cut must go from one parallel side to the other. It must also be parallel to one of the sloping sides.
  - ◊ To make a triangle and a parallelogram, the cut must go from a corner through to one of the parallel sides. It must also be parallel to one of the sloping sides of the trapezium.

- *Is it possible to make a square or a rhombus?*
  - A square can be made from a trapezium that has two adjacent right angles (as for a rectangle). However, the parallel sides of the trapezium must be at least as long as the distance between the parallel sides.
  - A rhombus can be made in the same way as a parallelogram but, as for a square, the parallel sides of the trapezium must be at least as long as the side of the trapezium used as one side of the rhombus.

Further activities

Activity 1

Ask the students to explore what shapes can be made when a parallelogram is cut in two with one straight cut. In what ways are the results similar to and different from the results of cutting a trapezium? Extend this to look at cutting a pentagon and/or a hexagon in two with one straight cut.