Geometric patterns

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| Year levelStrand(s)Lesson lengthCD Code | Year 7Space60 mins[AC9M7SP02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7SP02&load-extra-subject=MATMATY7&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=00fa25a5-0ce3-4dd9-bf12-4d6141ee9d22&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick) |
| Lesson summary | As geometric explorers, students use intuition and logic to establish the side and angle properties of triangles and special quadrilaterals. |
| Learning intention | We are learning to classify and construct triangles, quadrilaterals and other polygons using geometric conventions.We use logical reasoning to explain the relationships between these shapes.  |
| Success criteria | By the end of this lesson, students can:* classify triangles and special quadrilaterals by their angle and side properties
* be able to explain their reasons built on knowledge and classification skills.
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| Why are we learning about this? | Shapes underpin our capacity to make pictures and graphics. We can apply this to art, design, architecture, construction, manufacturing, physics, engineering, chemistry, biology and medicine among other important uses. |
| Prerequisite student knowledge and language | Acute, obtuse and right angleBisect, intersect, diagonalAxis of symmetryAdjacent, opposite |
| Resources | Teacher’s slides (PowerPoint)Design from Asia worksheet (Word) Classifying triangles templates (Word, print A3) Impossible triangles poster activity (Word, print A3)Properties of quadrilaterals (Word, A4, one per student)Blu tac, A3/poster paper, coloured markers, ruler, pencil, eraser, scissors  |

Curriculum information

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| Achievement standard | Students classify polygons according to their features. |
| Content description | Students classify triangles, and other polygons according to their side and properties; identify and reason about relationships. [AC9M7SP02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7SP02&load-extra-subject=MATMATY7&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=00fa25a5-0ce3-4dd9-bf12-4d6141ee9d22&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick) |
| General capabilitiesCross-curriculum priority | **General capabilities**Numeracy* understanding geometric properties ([Level 4](https://v9.australiancurriculum.edu.au/f-10-curriculum.html/learning-areas/mathematics/year-7/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7SP02&general-capability-code=N&element-code=NM&sub-element-index=0&sub-element-code=NMUGP&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))

Critical and Creative Thinking * draw conclusions and provide reasons ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum.html/learning-areas/mathematics/year-7/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7SP02&general-capability-code=CCT&element-code=CCTANA&sub-element-index=0&sub-element-code=CCTANAB&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))

**Cross-curriculum priority** * Asia and Australia’s engagement in Asia
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| Areas of challenge | An area of challenge for students is recognising the properties of plane shapes when they have a different orientation. For example, a square that is displayed diagonally or an irregular five-sided shape is a pentagon.  |
| Strategies | [Concrete, Representational, Abstract (CRA)](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/concrete-representational-abstract-cra/) [Metacognitive strategies](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/metacognitive-strategies/) [Culturally responsive pedagogy](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/culturally-responsive-pedagogies/)  |

Lesson structure

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| Hook15 mins | Note: This lesson does require time for pre-preparation and hands-on materials. Ensure you are familiar with the lesson and materials required before beginning the lesson. Arrange class into groups of 3 and 4.* For this introductory task, download the Designs from Asia worksheet and print out (in colour preferably) the designs for as many groups of three or four that you require. Have the teacher’s slides ready to go but don’t display it yet.
* In groups of three or four, students are provided with one of the six images. Instruct students to jot key words in response to each of the three prompts that accompany the images: what do you see, what do you think and what do you wonder?
* Display the slides 1–7 asking student groups to share their thoughts and ideas with the class. (These could be collated in a Word Cloud apps and software like Mentimeter or invite students to write key words on the whiteboard.)
* When you reach slide 8, pose the question: What type of geometric explorer are you?

Logical Explorers: take careful steps to uncover the mysteries of shapes and spacesIntuitive Explorers: rely on their inner sense to uncover the hidden wonders of geometry* Ask students to take a couple of minutes to reflect and think about the processes they took when analysing their images.
* Move to slide 9: ‘Geometry requires both intuitive thought and logical reasoning’ with the learning intentions. Ask students based on the learning intention, what they think the success criteria would look like.

**Differentiation** (enable): To enable abstract thinking, modify the lesson into a whole class discussion and ask students to reflect for a few minutes afterwards with each image as to whether their thoughts were more intuitive, or whether they were more logical and sequenced. Be ready to explain intuition and logic to your students; support explanations with two different ‘thought’ examples from the images.  |
| Explore35 mins | **Classifying triangles** Note: Pre-prepare by downloading and printing the Classifying triangles document and cutting out the triangles ready to go. You need markers and Blu tac for this task. Ensure there are at least two triangles per student.* Display triangles based on their angles (acute, right, and obtuse) and their sides (scalene, isosceles, and equilateral) from slides 10–11. Engage students in a discussion about the meanings of each term and the process of naming triangles based on their angles and sides.
* Slide 12 shows the classifying triangle table. Triangles discussed have been placed into their appropriate position on the table. Flick back and forth slides as needed to aid explanation. (It is best to display this table onto the whiteboard or draw it up.)

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|  | Acute | Right | Obtuse |
| Scalene |  |  |  |
| Isosceles |  |  |  |
| Equilateral |  |  |  |

* Distribute two triangles to each student and ask them to write the appropriate name for each of their triangles, such as ‘right scalene triangle’. Invite students to place one of their triangles in the corresponding cell of the grid on the board.
* Facilitate a discussion about the empty cells in the grid, specifically the ‘right equilateral triangle’ and ‘obtuse equilateral triangle’ cells. Explore and explain why there are empty cells, emphasising the properties of equilateral triangles that dictate that all three angles are 60 degrees (which excludes the possibility of a right or obtuse angle).

Use a spare paper triangle to demonstrate that angles in a triangle add up to 180°, by tearing off vertices of a triangle and rearranging to create a straight line as shown in the diagram below. Three angles a, b, c making up 180 degrees* Ask students to now do the same with their remaining second triangle. Facilitate discussion and notice students who are puzzled or surprised. This angle investigation gives students another way of moving from concrete to abstract when thinking about angles, though be prepared for questions: what if the vertices do not add to 180 degrees. Assure students that they will now investigate this further in the next task.

**Poster – Impossible and possible triangles** * Students work in groups for this task. Hand out the Impossible triangles poster activity (printed on A3 for more space) and distribute it to each group, as well as rulers, pencils, protractors, erasers and coloured markers.
* Students spend 20 minutes constructing and classifying the possible triangles on one side of their paper, they justify why the impossible triangles cannot be constructed on the reverse side of their poster.
* Iteration: print this on A4 or email a copy to students to work individually.

 **Investigating properties of quadrilaterals** * Iteration: students can continue to work in their groups, individually or as a class or make this an assessment or homework task if time is limited.
* Distribute the Properties of quadrilaterals worksheet where students are given a table to fill in OR have students draw this table in their exercise books.
* Using the approach used earlier for classifying triangles, have students investigate quadrilaterals and classify them (example resource: [Classifying polygons](https://topdrawer.aamt.edu.au/Geometric-reasoning/Misunderstandings/Classifying-polygons))
* Prompt with questions and support students as you walk around the room while they work.

**Differentiation** (support): provide scaffolding using the quadrilateral infographic shown on the optional slide 16.**Differentiation** (enrich): Have students create their own classification table from their own independently sourced polygons. Slide 14 teaching notes gives the solution and further resources for differentiation.

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|  | Square | Rectangle | Parallelogram | Rhombus | Trapezium | Kite |
| How many sets of opposites sides are equal? |  |  |  |  |  |  |
| Are opposite sides in parallel? |  |  |  |  |  |  |
| Are adjacent sides equal? |  |  |  |  |  |  |
| How many right angles are there? |  |  |  |  |  |  |
| Are opposite angles equal? |  |  |  |  |  |  |
| Are the diagonals equal? |  |  |  |  |  |  |
| Do diagonals bisect each other? |  |  |  |  |  |  |
| Do diagonals intersect at right angles? |  |  |  |  |  |  |
| How many axes of symmetry?  |  |  |  |  |  |  |

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| Summary and reflection10 mins | **Discussion and Summarise** * Return to slides 8 and 9. Reflect on the question posed in the introduction: ‘What type of geometric explorer are you?’
* Ask students whether they agree with the statement: ‘Geometry requires both intuitive thought and logical reasoning.’
* Summarise the learning intentions and success criteria.
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| Assessment | This lesson presents opportunities for assessment as described below.Show the 321 Exit slip (slide 15) or read it out.* 3 geometric properties I learned today.
* 2 things I want to learn more about.
* 1 question I still have.

Set the following tasks and students can finish it for homework to hand in later.* Geometric Patterns remaining activities in the properties of quadrilaterals worksheet handed earlier.
* Students create a concept map showing all the connections between the special quadrilaterals.
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