Polygon Puzzle

Purpose:

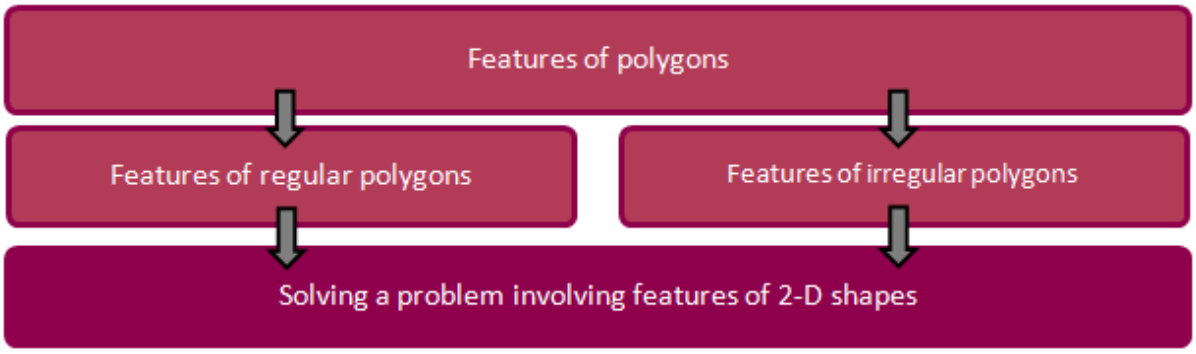
The purpose of this activity is to engage students in using the properties of irregular polygons to solve a problem.

Achievement Objectives:

GM3-3: Classify plane shapes and prisms by their spatial features.
GM3-4: Represent objects with drawings and models.

Description of mathematics:

The background knowledge and skills that should be established before and/or during this activity are outlined in the diagram below:



Features of polygons
Name the 2-D closed shape that has seven sides.

Features of regular polygons
If a triangle has all three angles of the same size, will the same be true of the lengths of the three sides?

Features of irregular polygons
If a quadrilateral has rotational symmetry order of one, is it a regular or irregular polygon?

Solving a problem involving features of 2-D shapes.
A road sign is made from two irregular pentagons joined together by their longest sides. The road sign is a regular polygon. What does the sign tell you to do?

This activity may be carried out with step by step guidance, or by allowing the student to follow their own method of solution. The approach should be chosen in sympathy with students' skills and depth of understanding.

Activity:

A maths teacher wants to make a puzzle out of irregular polygons, one each from a triangle to a heptagon, that fit together to make an A4 sheet of card.

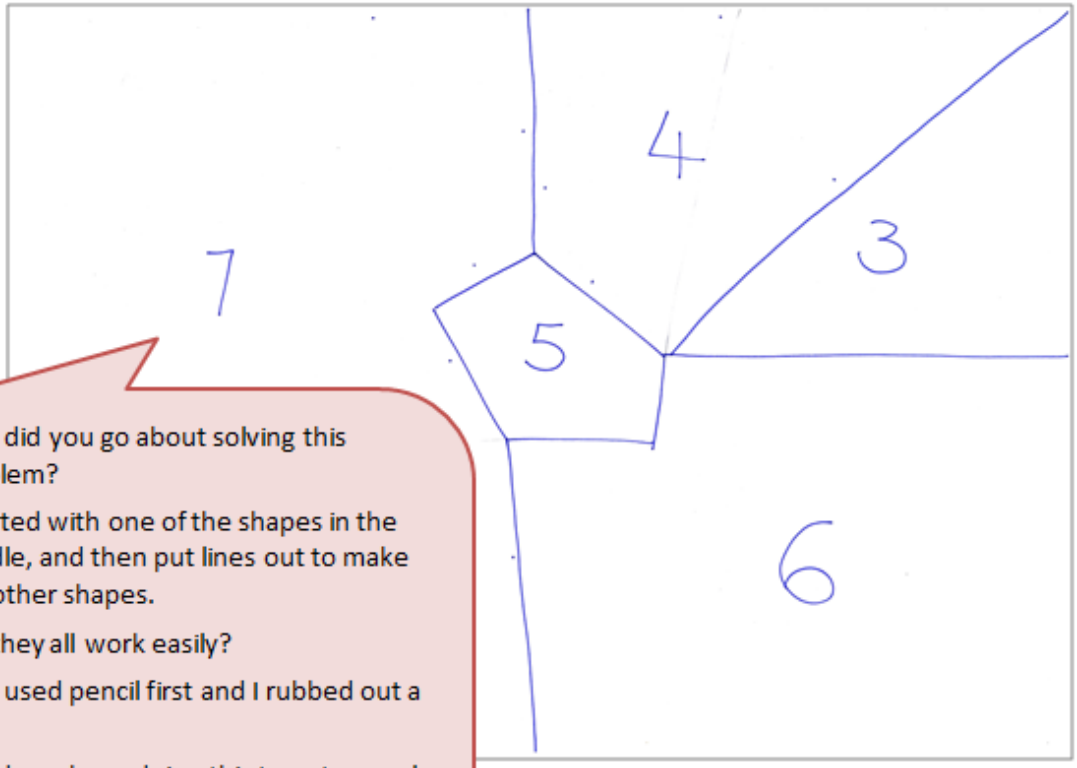
Can you design such a puzzle?

The arithmetic approach

The student is able to incorporate knowledge of features of polygons to solve a geometric problem.

Prompts from the teacher could be:

1. What are the features an irregular polygon?
2. Consider what the different irregular triangles, quadrilaterals, pentagons, hexagons and heptagons might look like.
3. Try to fit one of each of an irregular triangle, quadrilateral, pentagon, hexagon and heptagon onto an A4 sheet of paper. (Light pencil, an eraser and a ruler will be useful!)



T: How did you go about solving this problem?

S: I started with one of the shapes in the middle, and then put lines out to make the other shapes.

T: Did they all work easily?

S: No, I used pencil first and I rubbed out a lot.

T: Could you keep doing this to get a puzzle with lots of pieces … say 19 pieces?

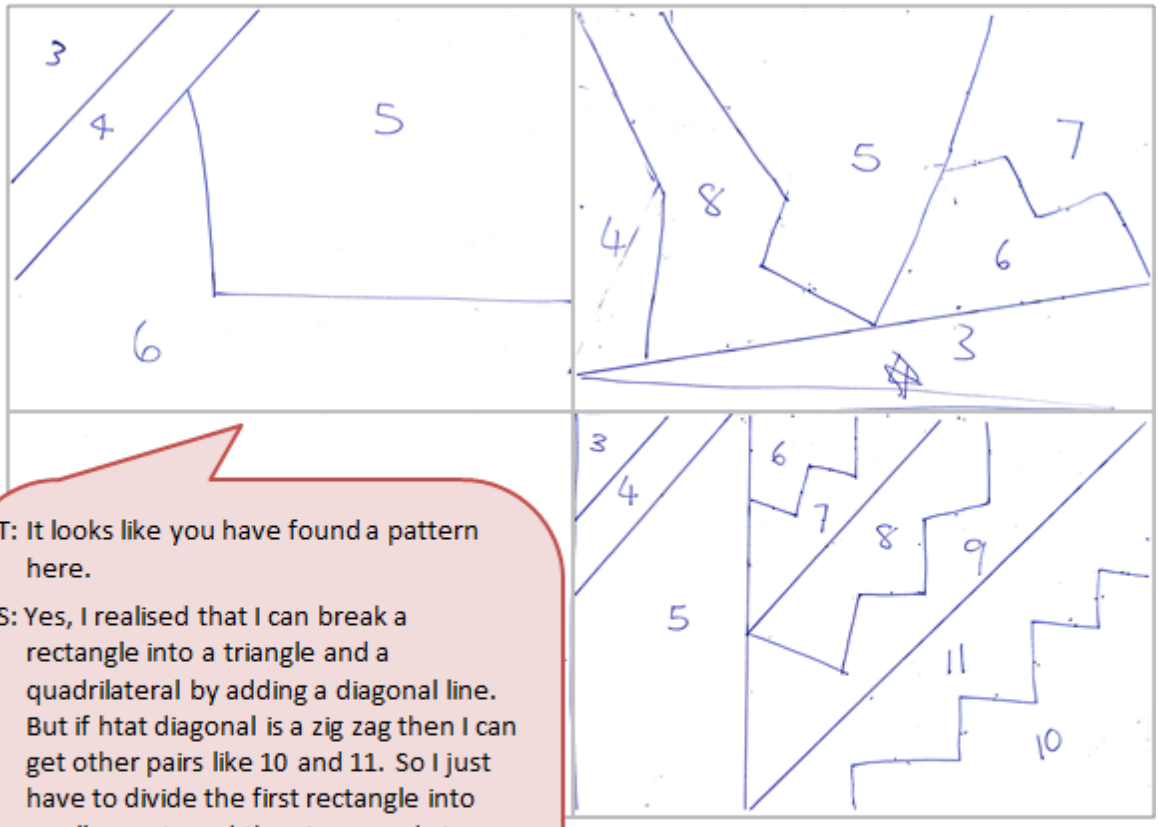
S: I don't know, it would take a very long time to work out.

The conceptual approach

The student is able to incorporate knowledge of features of polygons to solve, and to generalise, a geometric problem.

Prompts from the teacher could be:

1. Can the A4 card be divided into an irregular triangle and quadrilateral?
2. Can the A4 card be divided into an irregular triangle, quadrilateral and pentagon?
3. Is there a pattern to adding each extra shape?
4. Can the A4 card be divided into an irregular triangle, quadrilateral, pentagon, hexagon and heptagon?
5. Could you keep going on making such a puzzle up to a 100-agon, or a polygon with even more sides?



T: It looks like you have found a pattern here.

S: Yes, I realised that I can break a rectangle into a triangle and a quadrilateral by adding a diagonal line. But if htat diagonal is a zig zag then I can get other pairs like 10 and 11. So I just have to divide the first rectangle into smaller parts and then I am ready to make lots of pairs of polygons.

T: So could you make the puzzle out of say, 100 pieces?

S: I could do 99 or 101. I would have to think about how to do even numbers.