Guess my Quad: Stage 3* Zach Thompson

My plan was to come up with three questions that would eliminate half of the possibilities each time, leaving only one quad. I played this as a fun game with my mum and used lots of different questions. It was pure trial and error. Often, we were just lucky, because if the answer had been the opposite, it would have forced a 4th question. Only 2 sets of questions met my original goals, these are highlighted.

1. Does it have a pair of parallel sides? **YES** (isosceles trapezium, rectangle, rhombus, parallelogram, square or trapezium)
2. Are its sides the same length? **YES** (rhombus or square)
3. Does it have a 90° angle? **NO** so it must be a rhombus (correct)

1. Does it have more than one pair of sides the same length? **NO** (isosceles trapezium or trapezium)
2. Does it have a line of symmetry? **YES** so it must be an isosceles trapezium (correct)

1. Does it have more than one pair of parallel sides? **NO** (isosceles trapezium, kite, trapezium or arrowhead)
2. Does it have any parallel sides at all? **NO** (kite or arrowhead)
3. If you joined the vertices, would they make a 90° internal angle? **YES** so it must be a kite (correct)

1. Does it have more than one line of symmetry? **NO** (isosceles trapezium, kite, parallelogram, trapezium, arrowhead)
2. Does it have at least one pair of parallel sides? **YES** (isosceles trapezium, parallelogram or trapezium)
3. Does it have two pairs of angles that are equal and opposite? **YES** so it must be a parallelogram (correct)

1. Are any of its sides the same length? **NO** (trapezium - correct)

1. Does it have two pairs of angles that are the same? **YES** (isosceles trapezium, rectangle, rhombus, parallelogram or square)
2. Are its sides the same length? **YES** (rhombus or square)
3. Does it contain a 90° angle? **NO** so it must be a rhombus (correct)

1. Are all of the angles the same? **YES** (rectangle or square)
2. Are all of its sides the same length? **NO** so it must be a rectangle (correct)

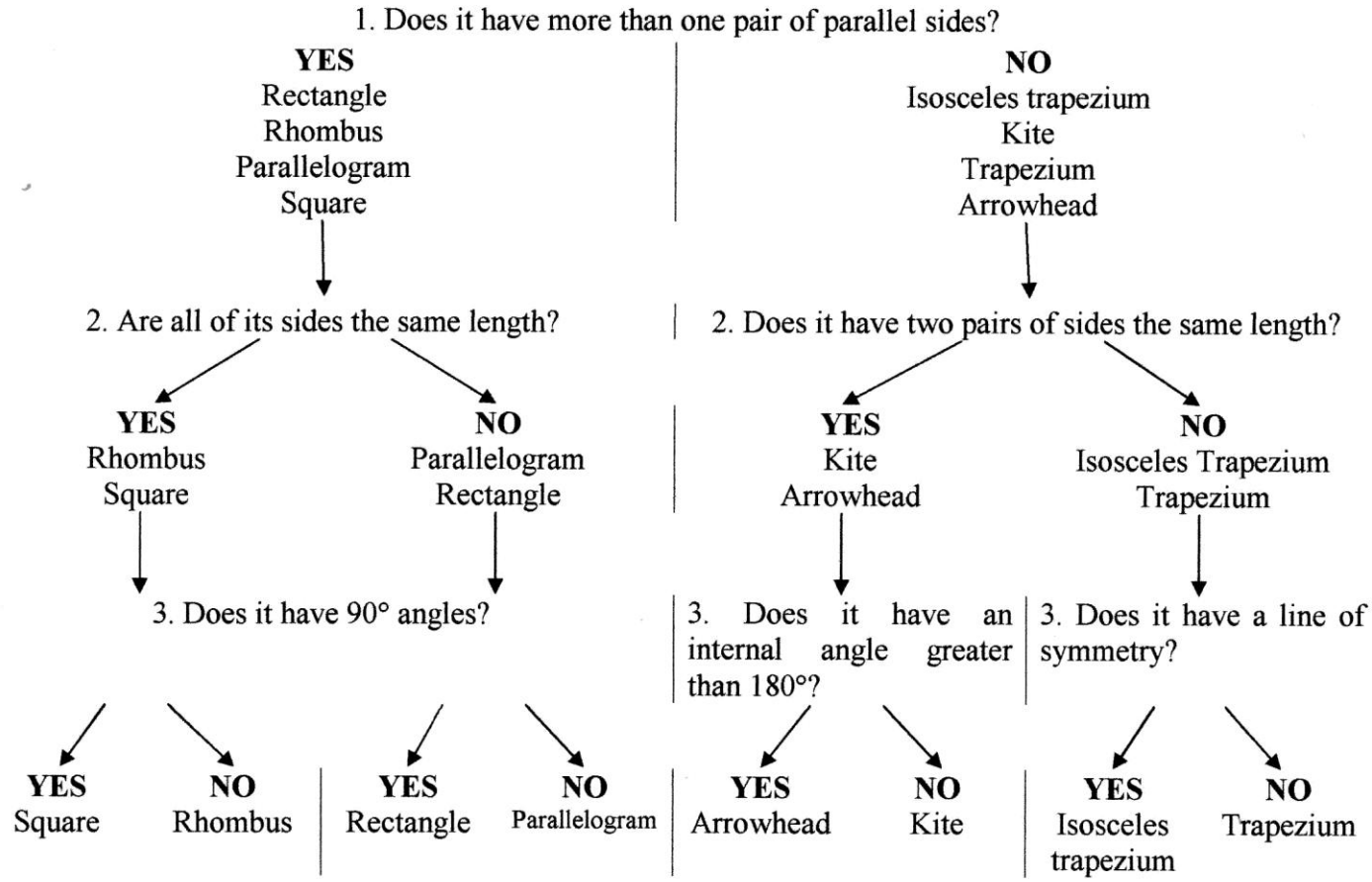
1. Does it have two pairs of parallel lines? **YES** (rectangle, rhombus, parallelogram or square)
2. Does it have 90° angles in it? **YES** (rectangle or square)
3. Are all its sides the same length? **YES** so it must be a square (correct)

1. Are at least two of your sides the same length? **NO** (trapezium - correct)

1. Does it have one or more pairs of parallel lines? **NO** (kite or arrowhead)
2. Does it have an internal angle greater than 180°? **YES** so it must be an arrowhead (correct)

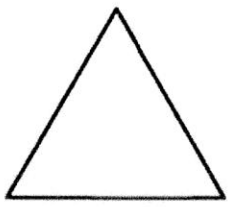
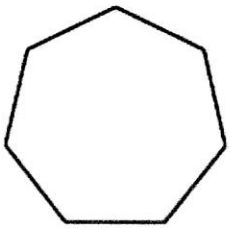
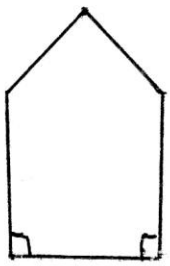
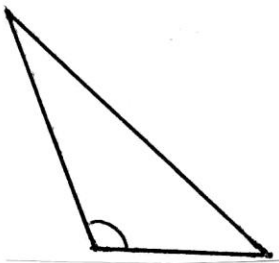
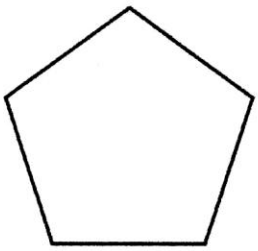
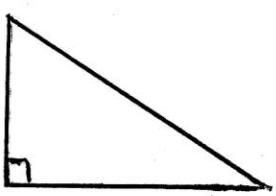
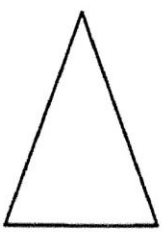
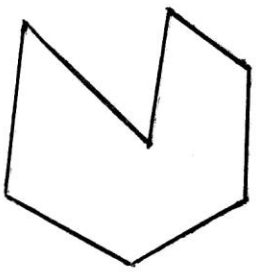
1. Does it have a line of symmetry? **NO** (parallelogram or trapezium)
2. Does it have two pairs of parallel lines? **YES** so it must be a parallelogram (correct)

The best question to ask is the one that will get rid of half every time, of the first questions asked this was:



If you follow this flowchart, you will guess the quad every time, guaranteed, because it sorts the shapes by common features and each question reduces the possibilities by fifty percent, leaving just one quad at the end.

To add more shapes, I just used the same model: 8 shapes and 3 questions that would eliminate half of the possibilities each time. The 4th question would be asked first, and would decide whether the shapes were quads or not. The extra shapes I chose were:

			
Equilateral triangle	Regular heptagon	Right angled pentagon	Obtuse triangle
			
Regular pentagon	Right angled triangle	Isosceles acute triangle	Concave heptagon

The first question would be:

1. Does it have an even number of sides?

YES	**NO**
Isosceles trapezium	Equilateral triangle
Rectangle	Regular Heptagon
Rhombus	Right angled pentagon
Kite	Obtuse triangle
Parallelogram	Regular Pentagon
Square	Right angled triangle
Trapezium	Isosceles acute triangle
Arrowhead	Concave heptagon
↓	↓
Move to quad set of questions	Move to non-quad set of questions

The non-quad set of questions could be:

2. Does it have 3 sides?

YES	**NO**
Equilateral triangle	Regular heptagon
Obtuse triangle	Right angled pentagon
Right angled triangle	Regular pentagon
Isosceles acute triangle	Concave heptagon
↓	↓
3. Does it have an internal angle of at least 90°?	3. Is it a regular polygon?

YES	**NO**	**YES**	**NO**
Obtuse triangle	Equilateral triangle	Regular heptagon	Right angled pentagon
Right angled triangle	Isosceles acute triangle	Regular pentagon	Concave heptagon
↓	↓	↓	↓
4. Does it have a 90° angle?	4. Are all its sides the same length?	4. Does it have 5 sides?	

YES	**NO**	**YES**	**NO**	**YES**	**NO**	**YES**	**NO**
Right angled triangle	Obtuse triangle	Equilateral triangle	Isosceles acute triangle	Regular pentagon	Regular heptagon	Right angled pentagon	Concave heptagon

Again if you follow this flowchart, you will guess the correct polygon every time. To continue to grow the model, you would need to double the existing base, so 16 new shapes next time. It would be easy to introduce 3d shapes, with the first question being: 'is your shape three-dimensional?' No = move to existing polygon set (quad and non-quad), YES = new set of 3d questions, where question 2 could be 'is it a prism?'...you would then need to find 8 prisms and 8 non prisms that you could then easily sort in just 3 further questions (which can be done).

Every time you double the base, you have to ask an extra question, if you can find enough shapes you could probably go on for as long as you can think of good questions. Just remember that you will then have to find an equal number of new shapes (that you can sort) to balance what you have already mapped.