

SHQ: How can I identify and record a pattern in a maths investigation (painted cube investigation)

This week, we are going to be looking at investigations which require us to try to identify a pattern.

Look at the example below:

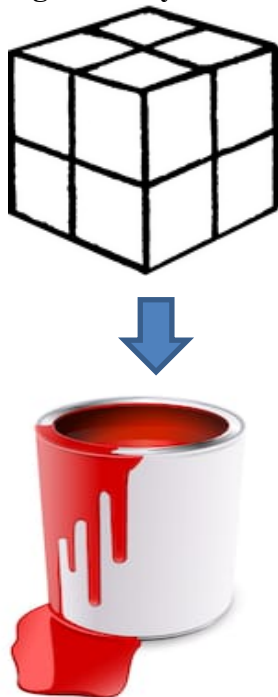


Imagine you had a wooden cube. You drop your cube into a pot of paint so that it is completely submerged in the pot and total covered in paint.

When you take the cube out of the paint, how many of the cube's 6 sides will be covered in paint?

Yes, that's right : all 6 sides of the cube will be covered in paint.

Now imagine that you had a larger cube, made up of 8 cubes



You are now going to drop your cube made up of 8 smaller cubes, into a pot of paint in the same way.

When you take the cube out of the paint, how many of the 8 little cubes will have 6 sides covered in paint? Will any of the 8 little cubes have less than 6 sides covered in paint?

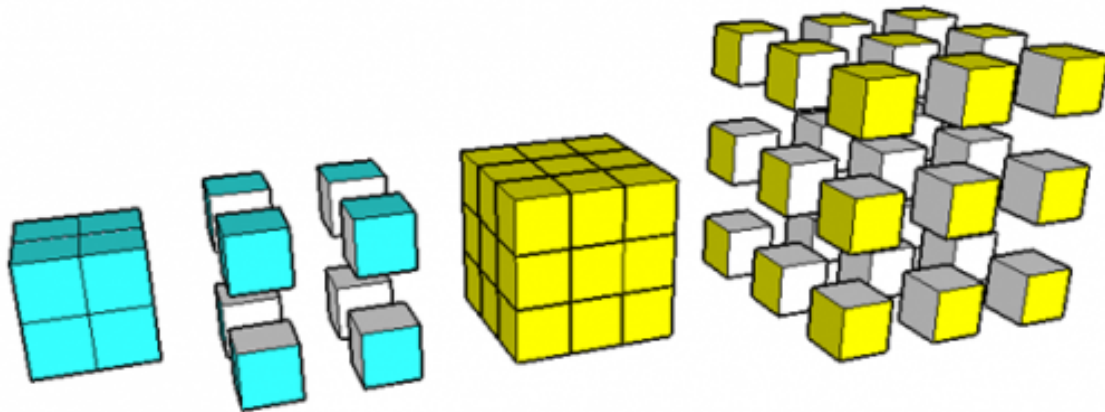
This time you will notice that:

None of the little cubes will have all 6 sides covered in paint due to the way they are 'stuck together' so some faces will not get any paint on them.

All 8 little cubes will however have 3 faces covered in paint (the other 3 are 'stuck' to another little cube)

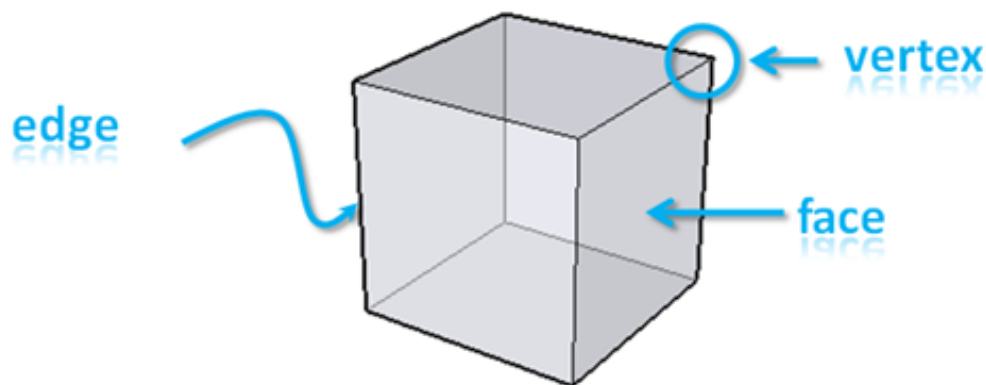
This can be shown more clearly on this 'exploded' diagram:

You will see the fully painted cube before being 'exploded' but in the second diagram, you can see how some faces of the smaller cubes are not painted.



Your investigation is to complete a table of results, beginning with the two cube sizes that we have investigated so far, and then continuing for at least 2 more cube sizes.

The table on which to record your results is shown below. The diagrams here explain what each part of the little cube is called, and what the types of little cube (shown on the table headers) means?

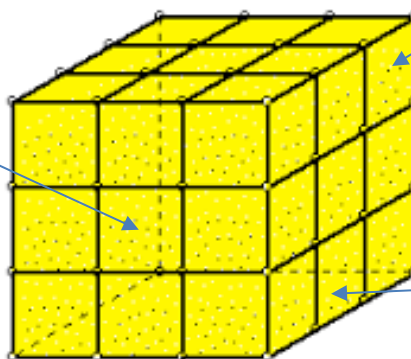


Wall unit cubes

These are the little cubes in the centre of each face of the large cube. These little cubes will have one painted side.

Core unit cubes

These are the little cubes in the 'core' of the larger cube that you can't actually see : these little cubes will not be painted at all.



Vertex unit cubes

These are the little cubes on the corners of the large cube. These little cubes will have three painted sides.

Edge unit cubes

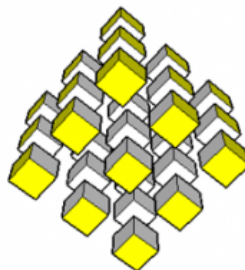
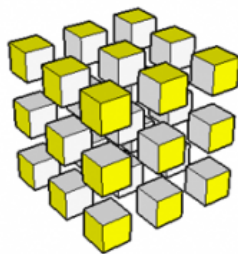
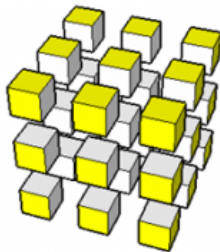
These are the little cubes on the edges of the large cube but not on the corners. These little cubes will have two painted sides.

able to record your findings.
or the first 3 sides lengths of cubes
at two more side lengths

- Written comments about the 'patterns' that can be identified
- Predictions about a larger cube size

Original cube's side length	Core cubes unit (no sides painted)	Wall unit cubes (one side painted)	Edge unit cubes (two sides painted)	Vertex unit cubes (three sides painted)	Total number of small cubes
2	0	0	0	8	8
3					
4					
5					
6					

To help you complete the 3 x 3 row and 4 x 4 row of the table, here are some useful diagrams of those cubes:



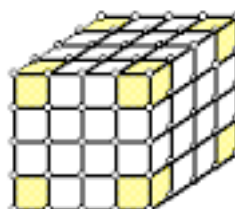
All blocks painted
1-sided



All blocks painted
2-sided



All blocks painted
3-sided



Do you notice any patterns in the numbers on your table? Can you predict the next row of numbers before you work it out? The solution for the above table is on the following page: We will be using these ideas in our next investigation on Worksheet 7.

Solution:

Your completed table should look like this:

Original cube's side length	Core cubes unit (no sides painted)	Wall unit cubes (one side painted)	Edge unit cubes (two sides painted)	Vertex unit cubes (three sides painted)	Total number of small cubes
2	0	0	0	8	8
3	1	6	12	8	27
4	8	24	24	8	64
5	27	54	36	8	125
6	64	96	48	8	316

Observations you may have noticed:

- The number of vertex cubes is always 8 -because any cube regardless of the size has 8 corners (vertices)
- The number of edge unit cubes increased in multiples of 12. If you subtract 2 from the cube side length and multiply this by 12, you will find the number of edge unit cubes.

Did you spot any other patterns?

Look for relationships between the cube side length and the other numbers in each column (as explained in the second example above)