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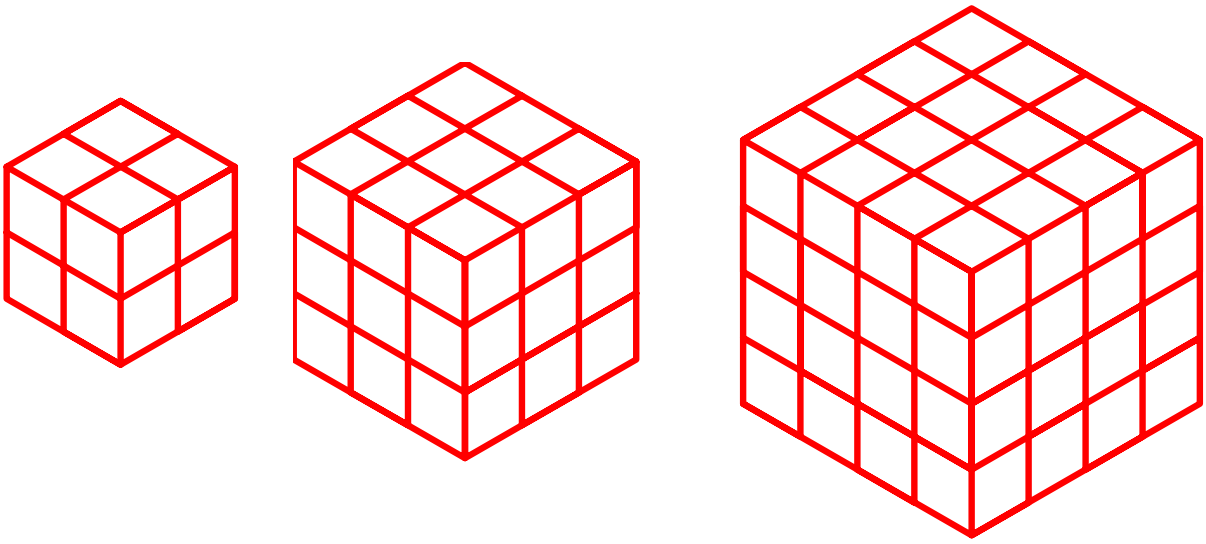
INVESTIGATION

Cubes



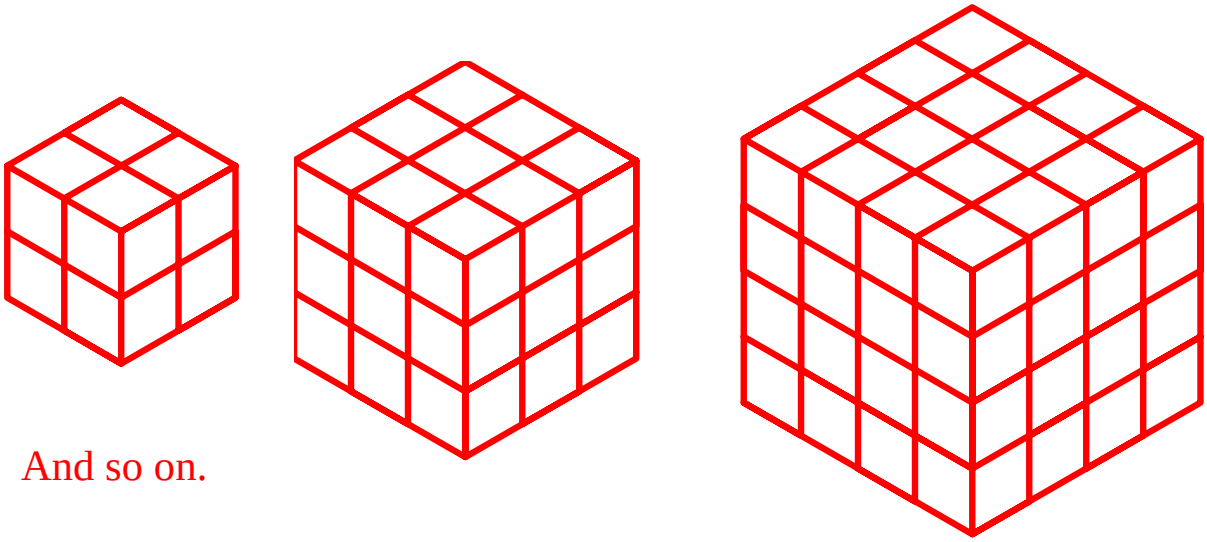
MathSphere

Cubes

Michelle has some cubes made from wood.

Lucky Michelle!

One cube is 2cm × 2cm × 2cm,
Another is 3cm × 3cm × 3cm,
Another is 4cm × 4cm × 4cm,



And so on.

She paints the outside of the cubes with red paint.
She then cuts the cubes into smaller cubes 1cm × 1cm × 1cm.

Your task:

Investigate for each cube she cuts up:
The number of small cubes that have paint on three faces.
The number of small cubes that have paint on two faces.
The number of small cubes that have paint on one face.
The number of small cubes that have paint on no faces.

Look for patterns and try to make up rules to tell you how many cubes will have three painted faces, two painted faces, one painted face or no painted faces.

You might like to use multilink cubes and sticky labels to help you solve this problem.

Answer Guide

There are always 8 cubes with three painted faces.
There are $12(n - 2)$ cubes with two painted faces.
There are $6(n - 2)^2$ cubes with one painted face.
There are $(n - 2)^3$ cubes with no painted faces.

This translates to:

Length of side	3 painted faces	2 painted faces	1 painted face	0 painted faces
2	8	0	0	0
3	8	12	6	1
4	8	24	24	8
5	8	36	54	27
6	8	48	96	64
7	8	60	150	125
8	8	72	216	216

The formulae above are given for teacher/parent info only. Don't expect the children to derive these.

When explaining the numbers in the table, some children will give explanations such as 'To get the number of cubes with 2 painted faces, take two off the number of cubes on an edge and multiply by 12. Some children will be able to give an oral explanation, but will find a written explanation difficult.