A TOWER OF SQUARES

GEOMETRY • NUMBER • PATTERNS/FUNCTIONS

- Square numbers
- Counting
- Pattern recognition
- Volume

Getting Ready

What You'll Need

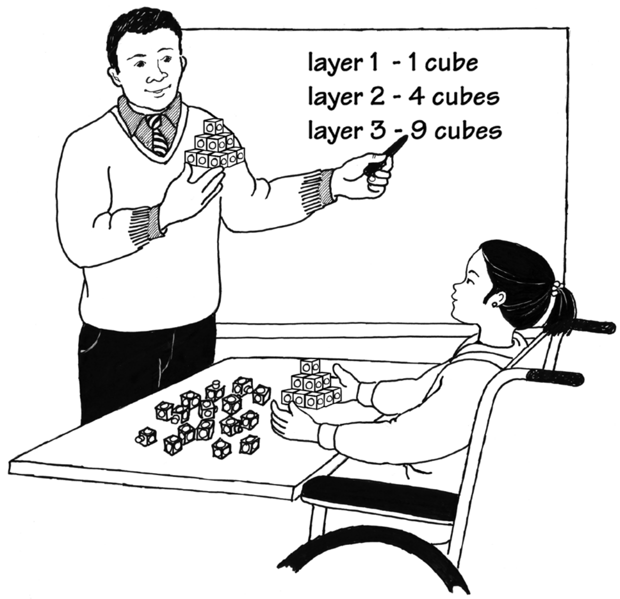
Snap Cubes, about 100 per pair

Calculators, 1 per pair

Overview

Children use Snap Cubes to build larger and larger square prisms and stack them to form a tower. They predict the numbers of cubes needed to produce larger squares and towers. In this activity, children have the opportunity to:

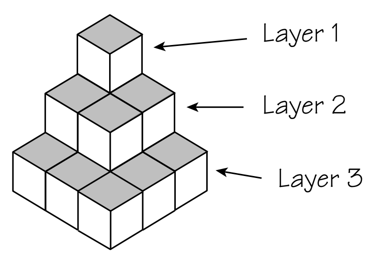
- investigate square numbers and growth patterns
- organize and analyze data
- use patterns to make predictions



The Activity

Introducing

- Display a Snap Cube and talk about its attributes, such as the number of faces, edges, and vertices.
- Snap four cubes together to form a 2 x 2 x 1 prism. Ask children to compare its attributes to the original cube shown.
- Stack the original cube on top of the 2 x 2 x 1 prism. Ask the children to predict what the next layer would look like.
- Ask a volunteer to build the next layer and add it to the tower to validate their predictions.



On Their Own

How many Snap Cubes do you need to build a many-layered tower of square prisms?

- Work with a partner. Build a tower made of layers of Snap Cubes according to these directions:
  - The first layer has 1 cube.
  - The second layer is a square prism that is 2 cubes long, 2 cubes wide, and 1 cube high.
  - The next layer is a square prism that is 3 cubes long, 3 cubes wide, and 1 cube high.
  - Continue to add layers of larger and larger square prisms until you run out of Snap Cubes.
- For each layer you make, record the number of cubes in the layer and the total number of cubes in the tower.
- Look for patterns in your recording.
- Predict the number of Snap Cubes you would need to build a tower with 11 layers.

The Bigger Picture

Thinking and Sharing

Call children together to create a class chart that looks like this:

Layer Number	Number of Cubes in the Layer	Total Number of Cubes in the Tower
1	1	1
2	4	5
3	9	14
..	..	..
..	..	..
..	..	..

Discuss the data.

Use prompts such as these to promote class discussion:

- What did you notice as you built your towers?
- What patterns did you notice in your towers?
- How did you find the number of cubes that would be needed to build the eleventh layer? The total number of cubes in the tower?
- How many cubes would be in the twelfth layer? How many cubes would be needed to build a 12-layer tower?

Writing

Ask children to write a set of directions that would help someone figure out how many cubes would be needed to build a 13-layer tower.

Teacher Talk

Where's the Mathematics?

In this activity, children use the geometric attributes of a square to investigate the concepts of square numbers. As they create the square layers of the tower, they generate the square numbers (1, 4, 9, 16, 25, 36, ...), look for patterns, and use those patterns to find the number of Snap Cubes needed for the square layers that are too large to build.

Organizing the data in a chart like this makes it easier to find and extend patterns.

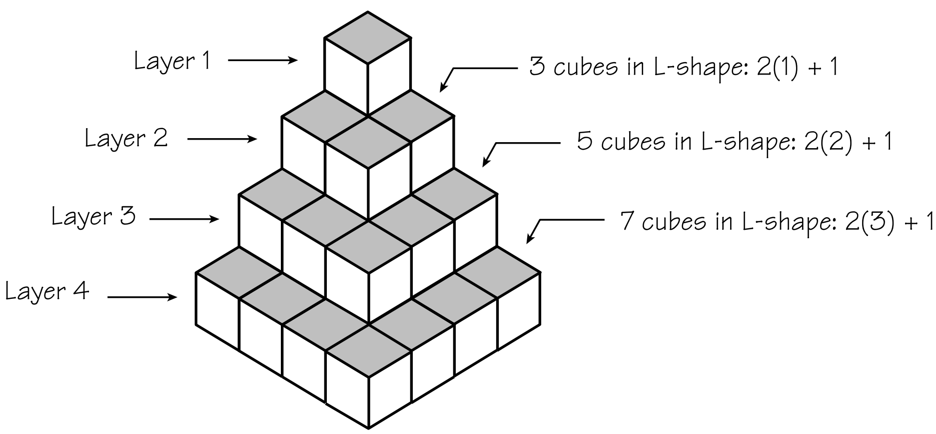
Number of Layer	Number of Cubes in the Layer	Total Number of cubes in the Tower
1	1	1
2	4	5
3	9	14
4	16	30
5	25	55
6	36	91
7	49	140
8	64	204
9	81	285
10	100	385
11	121	506

Children may use different methods for finding the data. For example, some children may recognize that the number of cubes in each layer can be found by multiplying the number of the layer by itself. Other children may recognize that the differences between each successive pair of entries in the "Number of Cubes in the Layer" column are consecutive odd numbers 4 – 1 = 3; 9 – 4 = 5; 16 – 9 = 7, and so on. They may then use this pattern to find the rest of the data for the second column.

Extending the Activity

1. Have children explain whether a square layer could have 400 cubes; 500 cubes.
2. Ask children to build towers with rectangular layers instead of square layers. One such tower could have layers that are 1 x 1 x 1, 1 x 1 x 2, 1 x 1 x 3, and so on. Another such tower could have layers that are 1 x 1 x 1, 1 x 2 x 2, 1 x 2 x 3, and so on.

Children who are more visual learners may look down from the top of the tower and recognize that each layer looks like an L-shaped addition to the previous layer. The new L-shape requires two times the previous layer number plus one more cube for the corner. This L-shape is a visual way of explaining the pattern of odd number differences that occur in the data found in the "Number of Cubes in the Layer" column.



Similarly, children will have various ways of finding the data in the third column. Some children will find the entries in the "Total Number of Cubes in the Tower" column by adding the previous entry in that column to the next number in the "Number of Cubes in the Layer" column: 1 + 4 = 5; 5 + 9 = 14; 14 + 16 = 30, and so on. Others might find the entries by adding all of the entries in the "Number of Cubes in Layer" column: 1 + 4 = 5; 1 + 4 + 9 = 14; 1 + 4 + 9 + 16 = 30, and so on.

The use of calculators allows children to focus on the patterns and concepts involved in the problem, rather than on the difficulty involved in manipulating the large numbers in the last few steps of the problem.
