Exploring Relationships on a Grid

What each table needs:

5 polystyrene cups, a ruler and grid paper

How can you calculate the height of cups stacked inside each other?

1. Work with a partner and make stacks of one, two, three, four, and five cups. Measure the height of each stack of cups. Record your measurements in a table. Measure in mm

2. Plot the points on a coordinate grid.

3. Describe the pattern of points. If the number of cups increases by one, by how much does the height of the stack increase?

4. Write a formula relating the height of the stack to the number of cups.

5. Use your formula to predict the height of a stack of 10 cups.

6. Make a stack of 10 cups and measure it. How accurate is your formula?

7. Reflect How did you develop a formula from your measurements?
For each cup added to the stack, it gets 5mm taller. Let $h$ = height of the stack in mm and $n$ = # of cups in the stack. 

$$h = 105 + 5n$$

constant term

[what you need to add to get the correct height]

$\Rightarrow$ 10 cups = 155mm high

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**Example 1: Plot Points and Examine Relationships**

The height of a stack of flowerpots can be modelled with the formula $h = 9 + 3n$.

**a)** Define the variables.

**b)** Create a graph showing the heights of one to four flowerpots.

**c)** Describe the pattern.

$a)$ $h =$ height of stack of flowerpots

$n =$ # of flowerpots

$c)$ Each extra flowerpot increases the height by 3cm
Example 2: Use Ordered Pairs to Understand Relationships

The student council is organizing a school play. The total cost to buy up to five boxes of tickets is shown. The set-up fee to design the tickets is $30.

<table>
<thead>
<tr>
<th>Number of Boxes, n</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost, C ($)</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
</tr>
</tbody>
</table>

a) Write the ordered pairs. Then, plot the points on a grid.
b) What does the ordered pair (0, 30) mean?
c) Describe the pattern of points. Then, write an equation to model the relationship.
d) How much will it cost for the student council to buy 35 boxes of tickets?
e) If the set-up fee is reduced to $27, how will your equation change?

\[(0,30) \quad (1,45) \quad (2,60)\]
\[(3,75) \quad (4,90) \quad (5,105)\]

c) Increasing by $15 for each extra box.

\[C = 30 + 15n\]

Let \(C = \text{cost in } \$\)

and \(n = \# \text{ of boxes}\)

d) Cost of 35 boxes

\[= 30 + 15(35)\]

\[= 30 + 525\]

\[= 555\]

e) Set-up fee is now $27.

\[C = 27 + 15n\]
Copy the Key Ideas box

To explore a relationship:
- Investigate the ordered pairs.
- Plot the points on a grid.
- Describe the pattern of points.
- You can use an equation to make predictions.

(1, 12), (2, 14), (3, 16), (4, 18), ...

As the x-coordinate increases by one, the y-coordinate increases by two.

\[ h = 10 + 2n \]

By substituting \( n = 15 \), you can predict that a stack of 15 flowerpots will be 40 cm high.

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