



It All Adds Up! Engaging 8-to-12-Year-Olds in Math Investigations

by Penny Skinner

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When I first saw a copy of It All Adds Up!, by Australian teacher Penny Skinner, I began reading it eagerly. I was searching for ways to teach arithmetic with the same excitement I had for the other areas of the math curriculum. In the introduction, Penny explains that her book explores teaching strategies for helping students become competent with computation while also developing an enthusiasm for mathematics. She writes about the importance of having children gain experience with computation through exploring mathematical topics and solving problems. She describes how she uses students' interests, problems, and ideas as the basis for her teaching. I finished the book in a single sitting. I liked it so much that I arranged with the Australian publisher to make it available for teachers here in the United States. Following is a brief excerpt from the beginning of Penny's "Multiplication" chapter.

Sequences of multiples are a rich source of patterns for investigation. These investigations build an understanding of number relationships, an enthusiasm for number patterns, and confidence in working with numbers.

An interesting starting point is the sequence of multiples of nine, as there are many patterns that children can find. If the class has discussed strategies for adding nine, this gives them a chance to practice the strategy.

To introduce an investigation of the multiples of nine and generate children's own natural language, a teacher can begin to list multiples of nine in order, without any comment. As the students watch, many will offer suggestions quite spontaneously about the numbers.

You're counting in nines.

You're adding nine each time.

There's a pattern.

They're in the nine times table.

To introduce the idea that these numbers are named to reflect their relationship, the teacher can ask: *What could we call these numbers?*

Some responses might be:

Nine numbers,

Nine times table numbers,

Times by nine numbers.

Once students have explored various possibilities, it is appropriate to introduce the term multiples of nine.

The teacher then asks the students how they could go about investigating the multiples of nine. They may suggest listing multiples of nine and looking for patterns. At this stage, their investigations begin. One way to generate a sequence of multiples is to use mental calculation; another is to use the constant function on a calculator.

Nines

I am counting in nines.

9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 108, 117, 126,
135, 144, 153, 162, 171, 180, 189, 198, 207, 216

I am going to make a list.

9	99	189
18	108	198
27	117	207
36	126	216
45	135	225
54	144	234
63	153	243
72	162	252
81	171	261
90	180	270

I found lots of patterns like the first numbers go up 1, 2, 3, 4, 5, 6, 7, 8, 9 then they go 10, 11, 12, 13, and keep going like that. Then the last numbers go down 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 and they start at 9 again and go down again. If you look at the numbers going across the first row ends in 9 and the next ends in 8 and it keeps going down till you get to zero on the end. Sometimes numbers next to each other turn around. I wrote 45 and then I turned it around to get 54. I wrote 234 and turned it around to get 243

It didn't happen in the second row.

This student corrected the omission of 99 when writing the multiples in a list.

I like to establish the pattern of working out mentally the first ten or so numbers in a sequence, checking them with a calculator, then continuing the sequence either mentally or with the calculator. Many children choose to use mostly mental calculation, as they are proud of being able to do so and they find it relatively easy once they become familiar with the patterns in a sequence. There are other children who turn fairly quickly to calculators. I sometimes sit with these children and support them to do more mental calculation.

The beginning of a report written by a group of four Year 6 girls is featured next. They had made notes as they worked and wrote the report up after concluding their investigation and explaining their discoveries to their teacher. The extensive discussions they were involved in together, and with their teacher, helped them write their ideas in quite a sophisticated way.

The multiples of nine

There are some interesting patterns in the sequence of multiples of nine. Here are the first ten numbers in the sequence.

<p>9 18 27 36 45 54 63 72 81 90</p>	<p>99 108 117 126 135 144 153 162 171 180</p>
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The arrows indicate one pattern. Note how the digits are reversed. What about the next ten numbers in the sequence?

A similar pattern occurs. We wondered if this would keep on happening.

<p>169 198 207 216 225 234 243 252 261 270 279 288 297 306</p>	<p>Yes! The pattern does continue. We also noticed another pattern:</p> <p>108 (9×12) 207 (9×23) 306 (9×34)</p> <p>We thought that 9×45 would be 405 following this pattern so we tried it out and we were correct. So the pattern will continue like this:</p> <p>504 (9×56) 603 (9×67) 702 (9×78) 801 (9×89)</p>
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A group of four describes the patterns they found from investigating multiples of nine.