The questions included in this activity can be solved by looking for a pattern and using it to get at the solution.

**Problem 1:** A Wizard’s assistant is paid in an unusual way. The assistant’s paycheque for the first week is one dollar. At the end of each week after the first week, the assistant is paid the amount of money earned the previous week plus two dollars for every week worked so far. What is the assistant’s paycheque, in dollars, for the fifty-second week?

To get started, calculate the paycheque for a particular earlier week, say the 9th or 10th week, looking for a pattern while you do so.

**Problem 2:** Suppose that the integer $N$ is the value of the following sum (with 52 terms):

$$1 + 11 + 101 + 1001 + 10001 + \cdots + 100\ldots0001$$

When $N$ is calculated and written as a single integer, what is the sum of its digits?

To get started, consider how each term in the sum is formed.

**Problem 3:** Using only the digits 1, 2, 3, 4, and 5, a sequence is created. The beginning of the sequence is shown below.

$$1, 2, 2, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, \ldots$$

The sequence starts with one 1, followed by two 2s, then three 3s, four 4s, five 5s, six 1s, seven 2s, and so on. What is the 1000th term in the sequence?

Some patterns can be tough to explain precisely using few words. The description above is likely sufficient to relay to you how the sequence is defined, but does not precisely define the remaining terms in the sequence. Can you come up with a more formal way to describe how this sequence is defined?

Discovering the correct patterns can lead you to the correct answers for these problems. Think about how you can justify that the pattern you discover in each of the problems is in fact correct.

**More Info:**
Check out the CEMC at Home webpage on Tuesday, May 12 for a solution to Patterns in Arithmetic.