**Activity 172. Read the article. Review your answers to the quiz in Activity 171.**

Our knowledge of ancient Egyptian mathematics from around 2000 B.C.E. comes chiefly from the Rhind papyrus (Ahmes papyrus). There we learn, for example, that the Egyptians followed a very natural system for denoting numerals: 1 was a vertical stroke |, 2 was two of them ||, 3 was |||, and 4 was ||||, and separate symbols were used for 5, 6, 7, 8, and 9, and for 10, 20, ..., 100, 200, ..., 1000, and so on. All other numbers were represented as groups of these symbols, usually arranged in order from largest to smallest. Like the Roman numeral system, the Egyptian system did not use a place-value system (the symbol for 5, for example, denoted “5” no matter where it appeared in the number). It is very difficult to do pencil-and-paper calculations without place-value notation, but the Egyptians always used a calculating board, much like an abacus, to perform arithmetic calculations, and needed only to record the results. They were therefore not hindered by their cumbersome numerical system. The ancient Egyptians were adept at multiplication, using a method of successive doubling to calculate products. This method is today called Egyptian multiplication.

Division problems lead to fractions. It did not occur to the ancient Egyptians to express fractions with numerators and denominators. In the Rhind papyrus, the mathematician Ahmes simply placed a dot over a number to indicate its reciprocal, except in the case of the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{1}{4}$, each of which had its own symbol. Thus, the Egyptians only dealt with fractions of the form $\frac{1}{n}$ (with the exception of two-thirds). Fractions with unit numerators are known today as Egyptian fractions. All other fractional quantities were expressed as sums of distinct Egyptian fractions. The Egyptian’s ability to compute such expressions is impressive. The Rhind papyrus provides reference lists of such expressions, and the first 23 problems in the document are exercises in working with such fractional representations.

The ancient Egyptians were adept at solving linear equations. They used a method called false position to attain solutions. This involves guessing an answer, observing the outcome from the guess, and adjusting the guess accordingly. As an example, problem 24 of the Rhind papyrus asks:

*Find the quantity so that when 1/7 of itself is added to it, the total is 19.*

To demonstrate the solution, the author suggests a guess of 7. That plus its one-seventh is 8, by far too small, but multiplying the outcome by 19/8 produces the answer of 19 that we need. Thus, 7 × (19/8) must be the quantity we desire.

The majority of problems in the Rhind papyrus are practical in nature, dealing with issues of area (of rectangles, trapezoids, triangles, circles), volume (of cylinders, for example), slopes and altitudes of pyramids (which were built 1,000 years before the text was written), and number theoretic problems about sharing goods under certain constraints.

Some problems, however, indicate a delight in mathematical thinking for its own sake. For example, problem 79 asks:

*If there are seven houses, each house with seven cats, seven mice for each cat, seven ears of grain for each mouse, and each ear of grain would produce seven measures of grain if planted, how many items are there altogether?*

This problem appears in Fibonacci's "The Book of the Abacus", written 600 years before the Rhind papyrus was discovered. A version of this problem also appears as a familiar nursery-rhyme and riddle, "As I Was Going to St. Ives."

*(by James Tanton, from Encyclopedia of Mathematics)*

*Table 29*

| **Rhind Papyrus** | **Nursery Rhyme** |
|---|---|
| If there are seven houses, each house with seven cats, seven mice for each cat, seven ears of grain for each mouse, and each ear of grain would produce seven measures of grain if planted, how many items are there altogether? | As I was going to St. Ives,<br>I met a man with seven wives,<br>Each wife had seven sacks,<br>Each sack had seven cats,<br>Each cat had seven kits:<br>Kits, cats, sacks, and wives,<br>How many were there going to St. Ives? |