

By Mark Swanson

Comparing and Contrasting Ancient Number Systems

Question:

How are ancient number systems and symbols of different civilizations similar and different?

Why this Topic?:

As a social studies teacher, I am responsible for teaching about ancient civilizations. Needless to say, I was very interested in learning about the Babylonian, Maya, Greek, Roman, Egyptian, Chinese, Hebrew, and Hindu-Arabic number systems. I believe that it would benefit my students to learn about these number systems in addition to their architectural, religious, and political achievements.

The Maya

The Maya had a positional number system just like the Babylonians. While the Babylonians wrote their numbers horizontally from right to left, the Maya wrote their numbers vertically from the bottom upward. This was my first exposure to a base 20 number system. The Maya had a shell shape to represent zero, a dot to represent the numeric value of one, and a bar that represented five. The Maya had nineteen different symbols made from the shell, dot, and bar and placed these symbols in the unit row on the bottom. The same nineteen symbols would be placed in the row directly above the unit to act as a multiple of 20. Above that row would be the value of 20 squared. In this manner, the Maya base 20 system was very similar to the Babylonian base 60 number system.



0	1	2	3	4
	•	••	•••	••••
5	6	7	8	9
	• 	•• 	••• 	••••
10	11	12	13	14
	• 	•• 	••• 	••••
15	16	17	18	19
	• 	•• 	••• 	••••

The Romans

The Romans had a base 10 number system but not a truly positional system such as the Babylonian, Maya, and Hindu-Arabic Systems. The Romans used seven letters from the Latin alphabet to represent 1, 5, 10, 50, 100, 500, and 1000. The Romans would place a line above a letter to multiple its value by 1000. The Romans also used a dot (.) to represent the fraction $\frac{1}{12}$ and an S to represent $\frac{1}{2}$. Two dots (..) would represent $\frac{2}{12}$ or $\frac{1}{6}$ and so

on. The Romans had impressive engineering feats despite a rather cumbersome number system.

I	1	XXI	21	XLI	41	LXI	61	LXXXI	81
II	2	XXII	22	XLII	42	LXII	62	LXXXII	82
III	3	XXIII	23	XLIII	43	LXIII	63	LXXXIII	83
IV	4	XXIV	24	XLIV	44	LXIV	64	LXXXIV	84
V	5	XXV	25	XLV	45	LXV	65	LXXXV	85
VI	6	XXVI	26	XLVI	46	LXVI	66	LXXXVI	86
VII	7	XXVII	27	XLVII	47	LXVII	67	LXXXVII	87
VIII	8	XXVIII	28	XLVIII	48	LXVIII	68	LXXXVIII	88
IX	9	XXIX	29	XLIX	49	LXIX	69	LXXXIX	89
X	10	XXX	30	L	50	LXX	70	XC	90
XI	11	XXXI	31	LI	51	LXXI	71	XCI	91
XII	12	XXXII	32	LII	52	LXXII	72	XCII	92
XIII	13	XXXIII	33	LIII	53	LXXIII	73	XCIII	93
XIV	14	XXXIV	34	LIV	54	LXXIV	74	XCIV	94
XV	15	XXXV	35	LV	55	LXXV	75	XCV	95
XVI	16	XXXVI	36	LVI	56	LXXVI	76	XCVI	96
XVII	17	XXXVII	37	LVII	57	LXXVII	77	XCVII	97
XVIII	18	XXXVIII	38	LVIII	58	LXXVIII	78	XCVIII	98
XIX	19	XXXIX	39	LIX	59	LXXIX	79	XCIX	99
XX	20	XL	40	LX	60	LXXX	80	C	100
								D	500
								M	1000



The Greeks

The Greeks had a number system that utilized the letters of their alphabet. Each of the 24-letters of the Greek alphabet, as well as

three other obsolete letters, was assigned a value from 1 to 900. A special symbol called the keraia was used to distinguish the numbers from the letters. To make large numbers, a keraia was placed in the lower left just before the letter to multiply the value of the letter by one thousand. A myriad symbol (M) was used for multiples of 10,000 to create even larger numbers. This was not a positional system, but a base 10 additive system that added the numeric value of the letters to get a total.

1	α	alpha	10	ι	iota	100	ρ	rho
2	β	beta	20	κ	kappa	200	σ	sigma
3	γ	gamma	30	λ	lambda	300	τ	tau
4	δ	delta	40	μ	mu	400	υ	upsilon
5	ϵ	epsilon	50	ν	nu	500	ϕ	phi
6	ς	vau [*]	60	ξ	xi	600	χ	chi
7	ζ	zeta	70	\omicron	omicron	700	ψ	psi
8	η	eta	80	π	pi	800	ω	omega
9	θ	theta	90	\koppa	koppa [*]	900	\sampi	sampi

*vau, koppa, and sampi are obsolete characters

Hindu-Arabic Numerals

The symbols that we use for numbers today had their origin in India. The Brahmi Numerals originated in India in the Third century B.C. These numerals evolved over time. Eventually, the Brahmi symbols evolved into the Nagari symbols and these were transmitted through Arab culture to Europe with more changes along the way. Nagari means “writing of the gods”, and it was these symbols that begin to take the shape of our numbers. In addition to giving us these numbers, the Indians also were the first to create a base 10 positional system. By 776 AD the Arab empire

was taking shape, and the numerals soon became the numbers used by Arabs in trade and engineering. During the Arab empire, Fibonacci traveled to North Africa with his father and became exposed to this base 10 positional system. He wrote a book called *Liber Abaci* in 1202 in which he promoted the Indian numeral system in Europe. He said, “There I had been introduced to the art of Indians’ nine symbols through remarkable teaching, knowledge of the art very soon pleased me above all else and I came to understand it.” Even though Fibonacci promoted the numerals, they were not practiced by most in Europe until the invention of the printing press by Johann Gutenberg in 1450. In 1549, a book titled, *Libro Intitulado Arithmetica Practica*, showed the correct format and sequence of the numbers that we use today.

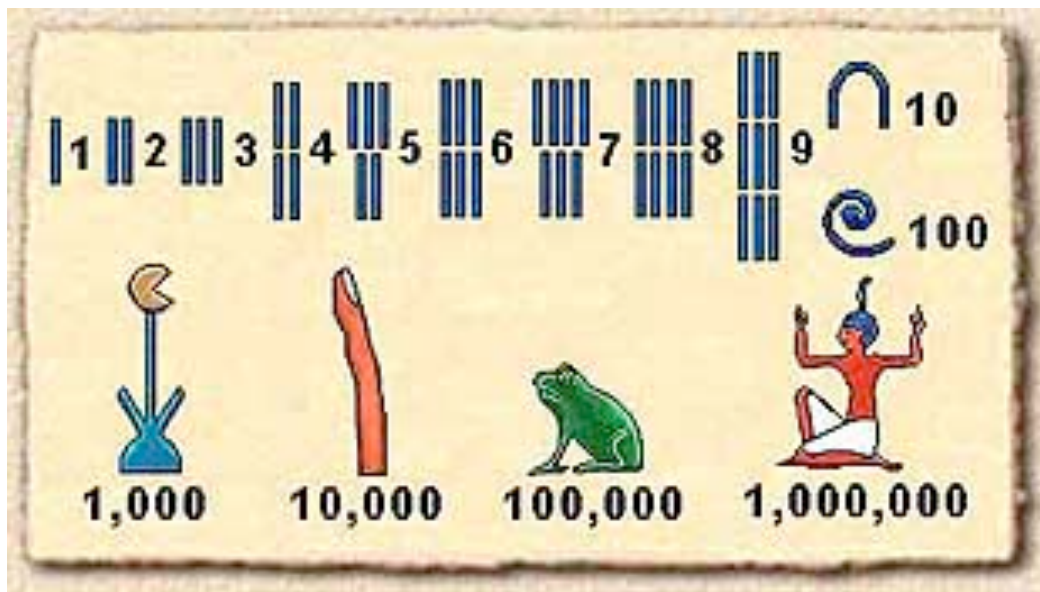
Brahmi	↓		—	=	≡	+	୮	୯	୭	୫	୬
Hindu	↓	୦	୧	୨	୩	୪	୫	୬	୭	୮	୯
Arabic	↓	.	୧	୨	୩	୪	୦	୬	୭	୮	୯
Medieval	↓	୦	୧	୨	୩	୪	୫	୬	୭	୮	୯
Modern		0	1	2	3	4	5	6	7	8	9

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Egyptians

The Egyptians had a base 10 number system just as many other ancient civilizations did. The Egyptians did not have a positional system but rather an additive system where numeric value was made by combining various symbols. Just like their written hieroglyphics, the Egyptians had symbols to represent their

numbers. The symbols for 1 through 9 contained single lines or strokes of equal number for each symbol. The symbols 10, 100, 1,000, 10,000, 100,000, and 1 million were made from objects from their everyday lives. For example, a coiled rope stood for 100 and a lotus flower stood for 1,000. The Egyptians would write their numeric symbols from left to right or from right to left. They also would write their numbers vertically in columns.



Hebrews


























Hebrew numeric symbols are similar to the Greek in that letter of the Hebrew alphabet are used to represent a numeric value. Again, like the Greeks, the Hebrew number system is not a positional system. This is an additive system where the value of each letter is added together and the position doesn't matter. Hebrew numbers are usually written from right to left with the largest number at the right. A symbol called a gersh, which looks like an apostrophe, is used to multiply numbers by a thousand.

Hebrew Numerals

1	א	10	י	100	ק
2	ב	20	כ	200	ר
3	ג	30	ל	300	ש
4	ד	40	מ	400	ת
5	ה	50	נ	500	תק
6	ו	60	ס	600	תר
7	ז	70	ע	700	תש
8	ח	80	פ	800	תת
9	ט	90	צ	900	תתק

Chinese




























































The earliest Chinese number system dates to the Shang Dynasty during the 14th century B.C. Tortoise shells uncovered in an archeological dig revealed this unique number system by recording the number of men killed in battle, prisoners taken, number of sacrifices, and the number of days and months. This system had a set of numeric symbols that represented the numbers 1 through 10. In addition, there were more symbols used to represent numeric values up to 5000. This was clearly a base 10 system that required an understanding of multiples of 10. I have found that most ancient number systems were base 10 systems- most likely due to the fact that we have 10 fingers. The Chinese system, like that of the Egyptians, was an additive system and not a positional system. Numeric values were created by placing these symbols next to each other.

				
1	2	3	4	5
				
6	7	8	9	10
				
20	30	40	50	60
				
100	200	300	400	500
				
1000	2000	3000	4000	5000

Babylonians

The Babylonians used only two cuneiform symbols to arrange into fifty-nine base units using a base 60 number system. The Babylonians then used a positional number system like we have today to arrange the numbers into columns. Therefore, the idea of place value is an ancient one. The first column was the unit column and contained any of the fifty-nine base units. This is exactly the way that we arrange numbers today, but we use ten different units for the first column – 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9 – instead of 59 different unit symbols. The next column contained multiples of 60. If one put the Babylonian symbol for one in this column, it had the value of 60, and if one put the symbol for two, it had the value of 120. This pattern would continue for all of the 59 unit symbols. The third column represented 60^2 or 3600. Again, placing the symbol for one in this column represented 3600. Placing the symbol for two in this column

represented 7200 and so on. Once I understood that the Babylonians used a positional system using powers of sixty rather than ten, I was able to easily interpret the meaning of this number system.

1 	11 	21 	31 	41 	51 
2 	12 	22 	32 	42 	52 
3 	13 	23 	33 	43 	53 
4 	14 	24 	34 	44 	54 
5 	15 	25 	35 	45 	55 
6 	16 	26 	36 	46 	56 
7 	17 	27 	37 	47 	57 
8 	18 	28 	38 	48 	58 
9 	19 	29 	39 	49 	59 
10 	20 	30 	40 	50 	

Other Questions?:

While researching these ancient number systems, I asked the question how many different number systems are there? I found that there were many more number systems than I had ever imagined. The Inca, Korean, Japanese, Mongolian, and Phoenician number system were just a few of the many number systems that I did not have time to research. Clearly, I discovered only the tip of the iceberg and a fully comprehensive study of ancient numeric symbols is beyond the scope of this assignment.

Middle School Connections:

It would be very easy to connect comparative number systems in a Social Studies classroom. Simply, whenever I have students research a particular civilization, I will require students to explain the mathematics of the civilization as well. A poster project like the one I am presenting would be a realistic project for Middle School students.

Sites Used:

<http://www-history.mcs.st-and.ac.uk/Indexes/Babylonians.html>

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