By Mark Swanson

The Babylonian Number System

Essential Questions:

Why did the Babylonians use a number system based on 60 instead of 10? How did the Babylonian number system work? How was the Base 60 number system different from a Base 10 number system?

Why this topic?

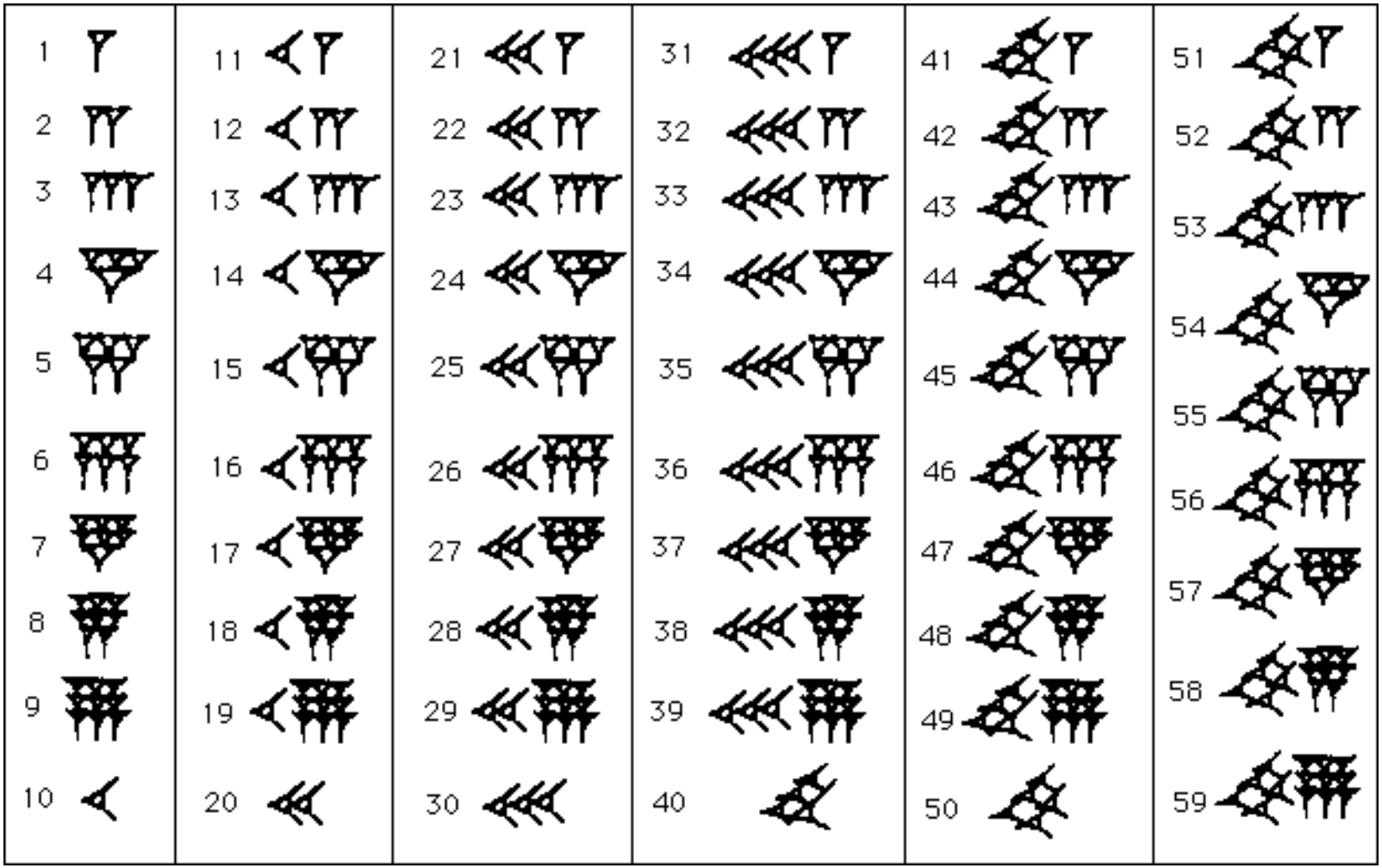
As a social studies teacher, I often have to teach about the early civilizations that developed in Mesopotamia. The Sumerians and Babylonians are two of the civilizations that we have covered in class. As part of this unit, I cover the cuneiform language of these civilizations. A favorite activity of my students is to make clay tablets and to write stories in the soft clay in cuneiform using a stylus. I have always known that the Babylonians had a sexagesimal number system, but I have never fully understood how it worked. Therefore, the main reason that I have choosen this topic is to gain an understanding of how it worked, and to develop lessons on Babylonian mathematics that I can incorporate into the social studies curriculum.


Middle East
Romania
Ukraine
Russia
Kazakhstan
Bulgaria
Black Sea
Caspian Sea
Uzbekistan
Greece
Georgia
Tbilisi
Azerbaijan
Armenia
Yerevan
Baku
Turkmenistan
Ankara
Turkey
Ashgabat
Azerbaijan
Cyprus
Nicosia
Syria
Tehran
Mediterranean Sea
Beirut
Lebanon
Damascus
Baghdad
Iraq
Iran
Afghanistan
Israel
Jerusalem
Amman
Jordan
Cairo
Kuwait
Pakistan
Persian Gulf
Egypt
Manama
Oman
Saudi Arabia
Bahrain
Qatar
Doha
Abu Dhabi
Gulf of Oman
Tropic of Cancer
Riyadh
Muscat
United Arab Emirates
Red Sea
Oman
Boundary Undefined
Sudan
Khartoum
Eritrea
Asmara
Sanaa
Yemen
Arabian Sea
Gulf of Aden
Djibouti
Socotra (Yemen)
Djibouti
Ethiopia
Somalia
Addis Ababa
30°
40° E
50
60
40°
30° N
20°
10°
0
400 km
0
400 mi

Findings:

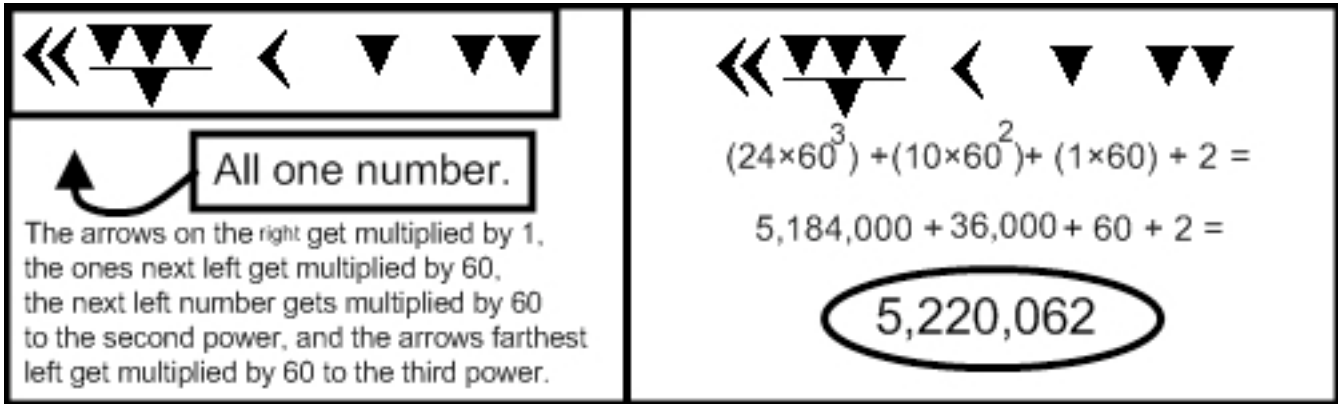
My first question as to why the Babylonians adopted a number system based upon sixty proved to be difficult to answer. One can see how a base 10 system would originate from the fact that a human has 10 fingers, or how a base 20 system would originate from 20 fingers and toes. It is not as easy to see the importance of the number sixty. It is clear that the Babylonians inherited this system from the Sumerians, but why any of the ancient civilizations chose sixty as a base is a bit of a mystery. Some historians have argued that the number sixty has many factors such as 1,2,3,4,5,12, 15, 20, 30, and 60. Having so many factors has made sixty a number that is easy to divide into amounts. Apparently, the system of weights and measures in the Fertile Crescent civilizations relied upon the fraction amounts of 1/3 and 2/3. This would make the number sixty easy to manipulate when calculating amounts of grain that the ancients used as currency for barter. Others argue that there were about 360 days in a year and that this would account for using 60. Still others argue that using the division of each finger into three sections could allow a person to count to sixty. Nevertheless, there is no clear explanation why the civilizations of Mesopotamia used sixty as a base.

My next task was to gain an understanding of how a base sixty number system worked. I first discovered that the Babylonians used only two cuneiform symbols to arrange into fifty-nine base units. (See chart below)



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.



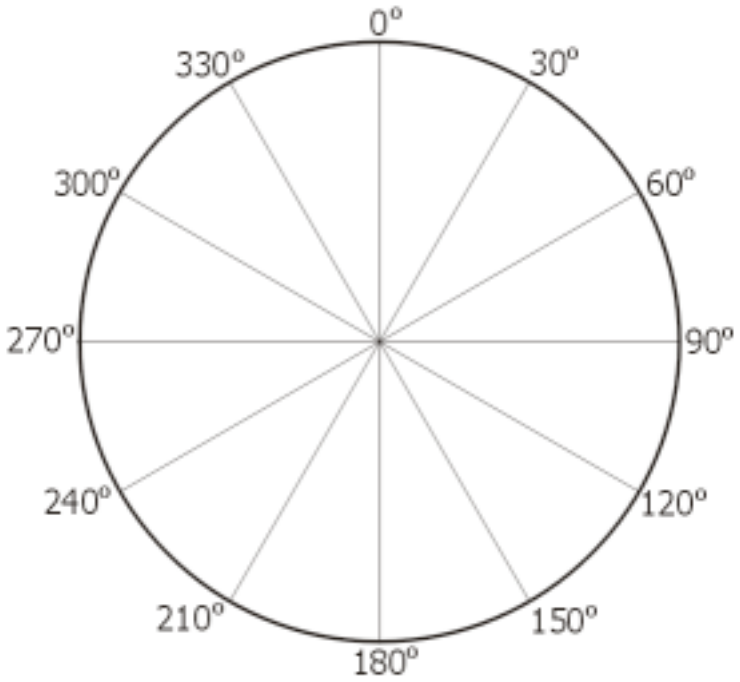
In looking at the differences between a base 10 and base 60 number system, I actually found more similarities than differences. Both systems rely upon different symbols to represent numeric values. Both systems are positional as where a symbol is placed in a column corresponds to its value. Also, both systems use powers of their base to increase value from column to column. The main difference would be that the Babylonians used two triangular or wedge-shaped symbols to create 59 base units where as we have 10 different symbols for base numeric values. Needless to say, calculating multiples

of sixty and multiples of 10 in the left-hand columns also is a major difference between the two systems.

Other Questions Raised:

In researching the Babylonian number system, I realized that the legacy of the base 60 number system can still be seen today. Every hour is divided into sixty minutes and every minute is divided into sixty seconds because of this system. Also, we divide a circle into 360 degrees. Because of this,

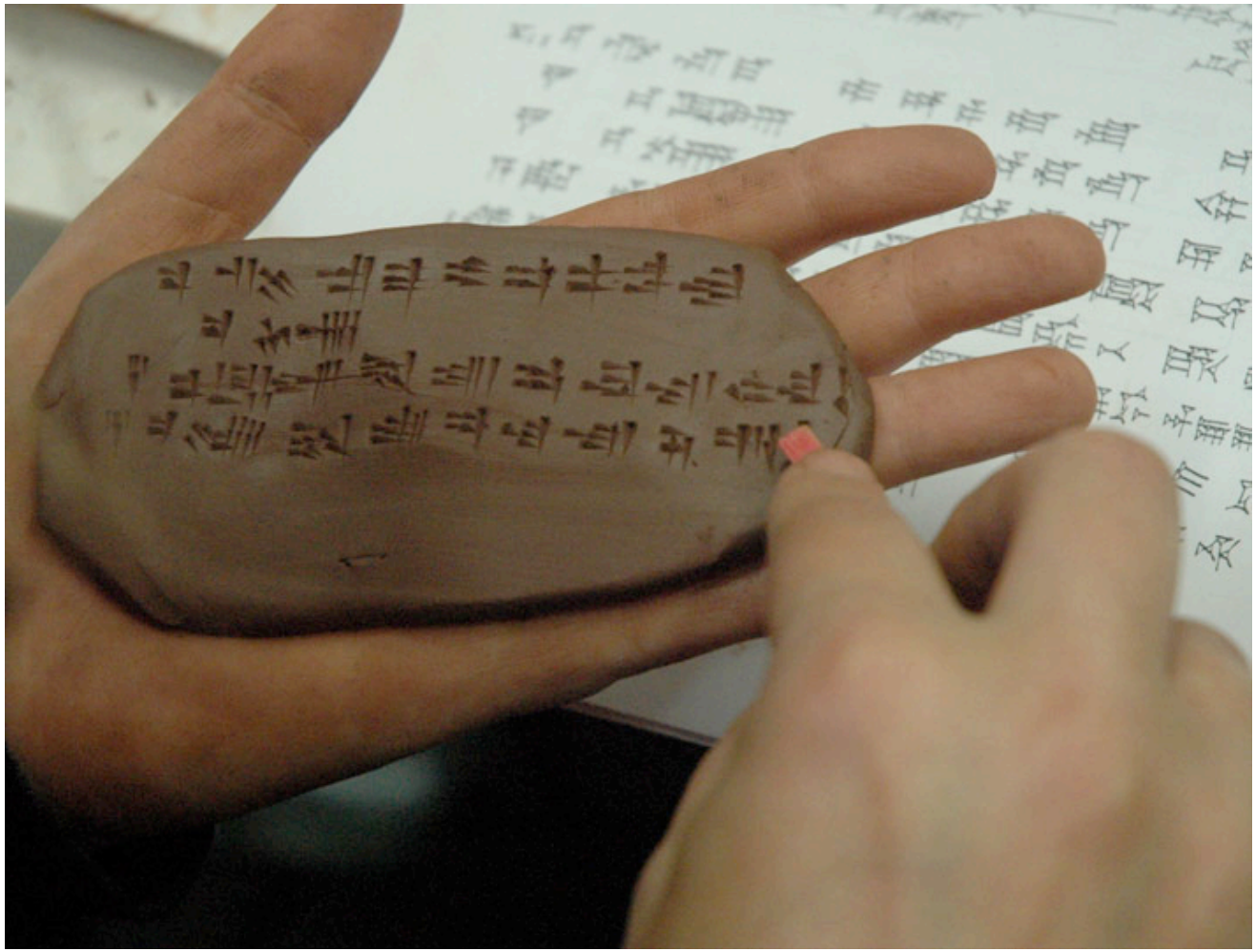
we still use this ancient number system to some degree. Also, I began to think about other number systems available today. The binary code that computer programmers use would be an example of a base two number system.



Middle School Connections:

I intend to use my knowledge of the Babylonian number system to teach my students how this unique system worked and how it is similar and different from our own positional system. My students will learn the different symbols for the 59 units in the Babylonian system, and students will learn to write these symbols on clay tablets in their correct positional format. I may also have

students do some basic adding and subtracting of the number to further gain an appreciation of the mathematical knowledge of ancient civilizations.



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