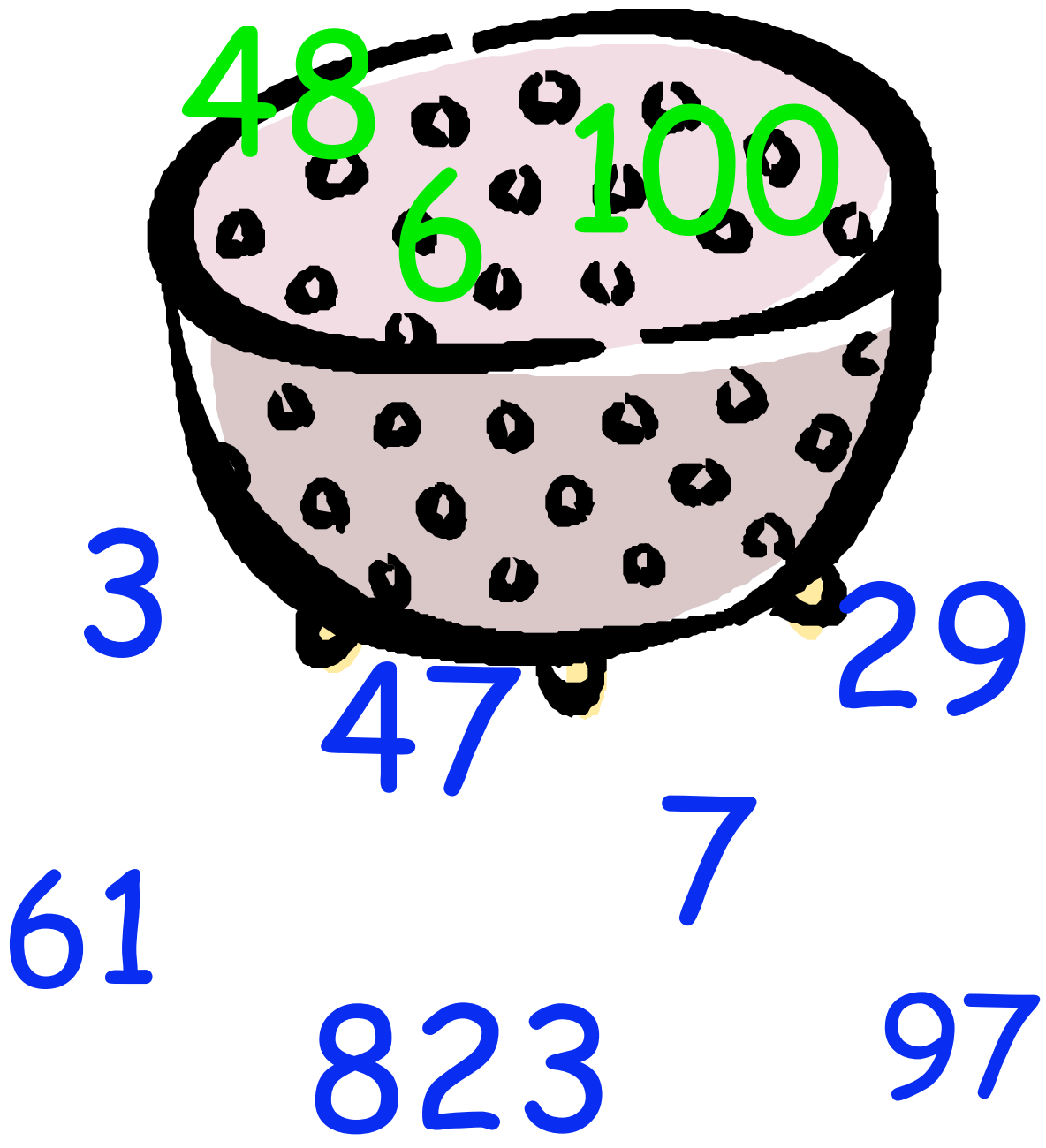

Brandi Irvin

June 13, 2007

History of Mathematics

Research - Prime Numbers

"God may not play dice with the universe, but something strange is going on with the prime numbers."

-Paul Erdos (Mackenzie, 1997)

Prime numbers have fascinated mathematicians and regular folk for centuries. They don't follow a discernible pattern, they are mysterious and intriguing. They can be twins or cousins. They are not perfect, but they can be sexy. Ptimes have been studied and played with by everyone from the ancient Greeks to French monks to professors at the University of Tennessee.There have been questions, arguments, proofs that didn't work, and proofs that did. Prime numbers have seduced us and we crave more knowledge and information about these curious numbers.

In 1570, Sir Henry Billingsley first translated Euclid's *The Elements* into English (Caldwell, 2006). Euclid's definition of prime numbers as translated from The *Elements* is:

Prime numbers are that unit alone measured.

Or:

A prime number is that which is measured by a unit alone.

The word "measured" was changed to "divisible" over time. The word "protos" was used and meant first in order of existence. Euclid, Aristotle, and Theon of Smyrna all viewed prime numbers as the beginning of a number. The word "prime" that we use today comes from the Latin word for first: primus. All other numbers (except for 1; we'll discuss why later) come from primes through multiplication.

Though there are records indicating the ancient Egyptians had knowledge of prime numbers, the ancient Greeks studied prime numbers in depth. The mathematicians from Pythagoras's school studied prime numbers as they related to perfect and amicable numbers. The Pythagoreans (500 BC to 300 BC) were interested in numbers for their mystical and numerological properties. Around 200

BC, the Greek librarian Eratosthenes created a way of calculating primes called the Sieve of Eratosthenes (O'Connor and Robertson, 2005).

In between the Pythagorans and Erotosthenes came Euclid. Though known mostly for his work in geometry, Euclid provided significant contributions to the theory of prime numbers. In *Elements* he proved that there are an infinite number of primes. Euclid also proved the Fundamental Theorem of Arithmetic, aka Prime Factorization, which proves that every integer can be written as a product of primes in a unique way. For example, the prime factorization of 18 is 2 x 3 x 3.

There have been many mathematicians who have made an impact on the study of prime numbers. Pierre de Fermat is credited with proving the theory of probability, but he also studied prime numbers. He is the first modern number theorist (Wells, 2005). He figured out a way to factorize large numbers that have no special form. Marin Mersenne was a French monk who understood the value of many minds working together. He kept correspondence with many scholars in Europe, including Fermat. His formula that he hoped would represent all primes failed, but it has been used in the investigation of large primes (O'Connor and Robertson, 2005).

The study of prime numbers has given birth to many interesting arguments. Let's look at the number **1**. Is it prime or not? The early Greeks did not believe 1 was prime. They considered it to be the beginning or generator of numbers (NCTM, 2006). If one considers our current definition of *prime* - a number who's factors are 1 and itself, then 1 is excluded because 1 is the ONLY factor. Today, 1 is generally excluded from the set of prime numbers because it's simpler to make theorems and formulas work (NCTM, 2006).

There have also been some disagreements about whether **2** should be prime. Euclid and Aristotle were willing to accept 2 as prime, but early Pythagoreans were

not. They believed that 2 was not a number at all - that it was the principle of even (NCTM, 2006).

Did you know that cicadas appear once every 7, 13, or 17 years? Is it a coincidence that the cycles are prime numbers? Do you think primes are sexy? Well, if you take a prime number (*n*) and add 6 to it, those numbers are sexy primes. (Our number *six* comes from the Latin word *sex* - don't teach this to middle schoolers!). If you have a digital 24-hour clock, it will show 211 prime numbers in each 24 hour cycle.

I'll leave you with an open question reguarding prime numbers: *Twin Primes* are consecutive prime numbers that differ by 2, such as 3 and 5. How many twin primes are there between 0 and 100? Are there a finite number of twin primes?

Classroom Application

While I have no intention of discussing sexy primes with my students, I do plan on using some of this information infused in our lessons on factors. I have two ideas for using this information to help my kids learn a little of the history of prime numbers.

I want to use the **Sieve of Eratosthenes** first as a tool for "discovering" the primes. It's a thinking activity that involves coloring so I know they'll enjoy completing the activity. I will then go into short history of primes. As a think/journal/discuss activity, I will give the students the origin of the word "prime" and ask why prime is a good name for these types of numbers. Depending on time constraints, I may also give this extension activity:

#	Factors	# of factors
1	1	1
2	1,2	2
3	1,3	2
4	1,2,4	3

They will need to complete the chart to 50 and then make observations about the relationships of numbers to their factors. I can put it on a large piece of poster paper, post it in the room and allow students to add their observations over the course of the unit or longer, depending on their interest.

I think prime numbers are addictive. I feel confident that at least one of my students next year will be as intrigued by them as I. My wish would be that this little bit of history and acitivity that I can give them will set them on a path to discover more about prime numbers on their own.

Works Cited

Caldwell, C. (2006). *Why are Prime Numbers Called Primes?* Retrieved June 7, 2007 from http://primes.utm.edu/notes/faq/WhyCalledPrimes.html

Mackenzie, D. (1997). Homage to an Itinerant Master. *Science* 275:759

National Council of Teachers of Mathematics. (2006). *Historical Topics for the Mathematics Classroom.* Virginia: National Coucil ofTeachers of Mathematics.

O'Connor, J. and Robertson, E. (August, 2005). *Marin Mersenne.* Retrieved June 11, 2007 from http://www-groups.dcs.st-and.ac.uk/~history/Printonly.Mersenne.html

O'Connor, J. and Robertson, E. (March, 2005). *Prime Numbers.* Retrieved June 6, 2007 from http://www-history.mcs.st-andrews.ac.uk/HistTopics/Prime_numbers.html

Wells, D. (2005). *Prime Numbers: The Most Mysteriaous Figures in Math.* New Jersey: John Wiley and Sons.