

Finding Prime Numbers using the Sieve of Eratosthenes

Eratosthenes was a Geek astronomer born in Cyrene (now Shahat, on the coast of Libya) about 276 BC. He died in Alexandria about 196 BC. He was a friend of Archimedes and was also a geographer, historian and mathematician. His nickname was “Beta”, the second letter in the Greek alphabet, because, although he was not the best at any pursuit, he was “second best” at a whole variety of interests. We will bump into him on many “math hikes” in our series.

Below is his method of finding Prime numbers. It is called a “sieve”, because just like a pot with holes in it, if you pour all the whole numbers into it (greater than 1), and “shake it”, all the composite numbers (non-primes) drop through, and you are left only with the prime numbers in the “pot”. In the late 1970’s, us computer nerds would use this method to program computers to write out the prime numbers. We would have races to see how short we could get the computer to spit out all the primes under 10 000. Ah yes, those were wild times!

The first step was to write out the numbers from 2 to say 100 as you see below.

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  2  3  4  5  6  7  8  9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
```

Then starting at 2, circle it, and then cross out all of the multiples of 2 until you get to 100. Here is what you will see.

```
  ②  3  4  5  6  7  8  9  10
11  12 13  14 15  16 17  18 19  20
21  22 23  24 25  26 27  28 29  30
31  32 33  34 35  36 37  38 39  40
41  42 43  44 45  46 47  48 49  50
51  52 53  54 55  56 57  58 59  60
61  62 63  64 65  66 67  68 69  70
71  72 73  74 75  76 77  78 79  80
81  82 83  84 85  86 87  88 89  90
91  92 93  94 95  96 97  98 99  100
```

Now go back to the first un-circled number, in this case 3, circle it, and then cross out all of the multiples of 3 until you get to 100. Repeat, by going back to next un-circled number, circle it and then cross out all of its multiples until you get to 100. When finished you will get the picture below.



As you can see, the crossed-out numbers are the composite, or non-prime numbers and they “fall through the holes” in the pot. The circled numbers that are left, are the prime numbers under 100.

Tomorrow, we will look at some practical uses for prime numbers.