AIAA

# AEROSPACE MICRO-LESSON

*Easily digestible Aerospace Principles revealed for K-12 Students and Educators.*

## LARGE NUMBERS

Millions, billions, and now trillions are often mentioned casually. In fact, they are quite large numbers. To help your students explore these concepts, we offer these illustrations of just how big these numbers are.

Common Core State Standards (CCSS):

- MATH.PRACTICE
  - MP2 Reason abstractly and quantitatively.

### *GRADES K-2*

CCSS.MATH.CONTENT.K.CC.A.1 Count to 100 by ones and by tens.

The author David M. Schwartz has a wonderful book for introducing younger students to large numbers called, How Much Is a Million? He uses simple comparisons to help children visualize and get an idea of the size of numbers like a thousand and a million. He has also suggested some great activities for working with and thinking about large numbers in his Magic of a Million Activity Book. For instance, have students make a chart with one side showing things they would like to have a million of - dollars, jellybeans, etc. On the other side of the chart have them list things they would not want a million of - pages of homework, bug bites, etc. (That would be good for a class activity with the teacher acting as note-taker for K-1, or 2nd graders could write things for themselves.)

Doing activities such as making paper chains or strings of paper clips and then joining them together can also make a big impression on youngsters. If each child makes a chain of ten, and then they begin linking them together, you could talk about numbers from a power of 10 perspective. "If ten of you hook your chains together, then we have a chain of 100. If we hook ten of those together, we have a chain of 1,000, and so on." Many schools celebrate the 100th day of kindergarten by doing projects like this, but only going up to 100. Kids can make necklaces by stringing 100 Froot Loops, counting out 100 steps and marking how far they have traveled, or creating a large banner with 100 handprints done in finger paint.

### *GRADES 3-5*

CCSS.MATH.CONTENT.4.NBT.B.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division.

## ***GRADES 3-5 (continued)***

One million is a large number. To give some idea about its size, we can think about how long one million seconds, one million minutes, or one million hours are.

For these grades, I would stick with one million seconds. We calculate how many minutes this is by dividing by sixty: 1,000,000 seconds / 60 = 16,666 minutes and 40 seconds. Ignoring the remainder, we divide the number of minutes by sixty to get hours: 16,666 minutes / 60 = 277 hours 46 minutes. Again, we can ignore the remainder or, if you prefer, we can round the number of hours up to 278. (You can also round up the number of minutes to 16,667.) Dividing the number of hours by 24 hours in a day gives 11 days and 13 (or 14 if you rounded) hours. So, one million seconds is just over eleven and a half days long.

It may help to do the long division on the board:

```
        16,666
60)1,000,000
   60
   400
   360
    40 0
    36 0
     4 00
     3 60
       400
       360
        40
```

This is our quotient of 16,666 minutes

This is our remainder of 40 seconds

```
       277
60)16,666
   12 0
    4 66
    4 20
      466
      420
       46
```

This is our quotient of 277 hours

This is our remainder of 46 minutes

```
      11
24)277
   24
    37
    24
    13
```

This is our quotient of 11 days

This is our remainder of 13 hours

## ***GRADES 6-8***

CCSS.MATH.CONTENT.6.NS.B.2 Fluently divide multi-digit numbers using the standard algorithm.

One million and one billion are large numbers. To give some idea about their size, we can think about how long one billion seconds and one million minutes are.

Start with one billion seconds. We calculate how many minutes this is by dividing by sixty: 1,000,000,000 seconds / 60 = 16,666,666 minutes and 40 seconds. Ignoring the remainder (or we can round up to 16,666,667 minutes), we divide the number of minutes by sixty to get hours: 16,666,666 minutes / 60 = 277,777 hours 46 minutes. Again, we can ignore the remainder or, if you prefer, we can round the number of hours up to 277,778. Dividing the number of hours by 24 hours in a day gives 11,574 days and 1 (or 2 if you rounded) hours. Dividing 11,574 hours by 365 days in a year gives almost 31.71 years; accounting for leap years by dividing by 365.25 days in a year gives about 31.69 years, or 31 years and 251 days. (The fact that 1900, 1800, and 1700 were not leap years does not figure in our immediate calculations, although they would make a difference in general calculations.) So, one billion seconds is about 31 years and 8 months long. Interested students can calculate it as precisely as they want to. Younger teachers can prepare to celebrate their billionth second (and older teachers their one-and-a- half-billionth second) with some sort of party, although a one-second-long party would be a very brief hoopla.

One million minutes, dividing by 60 to convert to hours, gives 16,666 hours and 40 minutes. We can round this up to 16,667 hours. To convert this to days, we divide by 24 hours in a day, giving a time of 694 days and 10 hours (or 11 hours if you rounded up). Two years are 730 days; thus, one million minutes comes to about 35 days short of two years. Students with baby brothers or baby sisters may want to calculate the exact day, correcting for a leap year if needed.

## ***GRADES 9-12***

CCSS.MATH.CONTENT.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

## ***GRADES 9-12 (continued)***

One million, one billion, and one trillion are large numbers. To give some idea about their size, we can think about how long one trillion seconds, one billion minutes, and one million hours are.

Start with one trillion seconds. We calculate how many minutes this is by dividing by sixty: 1,000,000,000,000 seconds / 60 = 16,666,666,666 minutes and 40 seconds. Ignoring the remainder (or we can round up to 16,666,666,667 minutes), we divide the number of minutes by sixty to get hours: 16,666,666,666 minutes / 60 = 277,777,777 hours 46 minutes. Again, we can ignore the remainder or, if you prefer, we can round the number of hours up to 277,777,778. Dividing the number of hours by 24 hours in a day gives 11,574,074 days and 1 (or 2 if you rounded) hours. Dividing 11,574,074 hours by 365 days in a year gives about 31,710 years; accounting for leap years by dividing by 365.2425 days in a year (the Gregorian calendar skips leap years three times every 400 years) gives about 31,690 years. One trillion seconds ago, people were still in the Stone Age. It was before the last Ice Age began and the Americas had not been peopled yet. Farming was not invented for another 20,000 years.

One billion minutes, dividing by 60 to convert to hours, gives 16,666,666 hours and 40 minutes. We can round this up to 16,666,667 hours. To convert this to days, we divide by 24 hours in a day, giving a time of 694,444 days and 10 hours (or 11 hours if you rounded up). Dividing by 365.2425 to convert to Gregorian calendar years gives 1,901 years and 118 days, or about 1,901 years and 4 months. This is recent enough to make it a moving target; one billion minutes before December 2015 was summertime in the year 114. A few months before the summer of 114, the Roman emperor Trajan started invading the Parthian Empire and extending the Roman Empire to its greatest geographical extent.

One million hours, dividing by 24 to convert to days, gives 41,666 days and 16 hours. Dividing by 365.25 to convert to years (this is a short enough period that the issue of skipped leap years in the Gregorian calendar does not come up) gives 114 years, 28 days, and 16 hours. Again, this is a short enough period of time to make "one million hours ago" a moving target; one million hours before December 2015 was November 1901. This is before the Wright Brothers' first flight; before both World Wars; before the construction of the Titanic.

Incidentally, the mathematician and computer scientist John von Neumann used to say that the optimal length of time for a class or lecture is one micro-century. This comes to about 52 minutes and 36 seconds.

Sixty Years Ago in the Space Race:

September 17, 1960

SM-65D Atlas suborbital US Air Force suborbital missile test at Cape Canaveral. Successful flight with apogee of 1,800 kilometers (1,100 miles).

September 25, 1960

An American "Pioneer" spacecraft was launched toward lunar orbit, but the second stage shut down early and the probe burned up about 17 minutes after liftoff.