NUMBERS IN BASE 10

Positional Number Systems

Our number system is a **positional number system**. We can write any number, as big or small as we want, using only 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. We can tell the size of the number by the position it's in.

Consider **2,473,019**. The 7 doesn't stand for just 7, it's really 70,000 because it's in the ten-thousands place.

2	**4**	**7**	**3**	**0**	**1**	**9**
10^6	10^5	10^4	10^3	10^2	10^1	10^0
1,000,000	100,000	10,000	1,000	100	10	1
Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones

In **word form**, this is:

Two million, four hundred seventy-three thousand, nineteen.

In **expanded form** it's either:

$$\mathbf{2 \times 10^6 + 4 \times 10^5 + 7 \times 10^4 + 3 \times 10^3 + (0 \times 10^2 +) 1 \times 10^1 + 9 \times 10^0}$$

Or:

$$\mathbf{2 \times 1{,}000{,}000 + 4 \times 100{,}000 + 7 \times 10{,}000 + 3 \times 1{,}000 + (0 \times 100 +) 1 \times 10 + 9 \times 1}$$

Or:

$$\mathbf{2{,}000{,}000 + 400{,}000 + 70{,}000 + 3{,}000 + 10 + 9}$$

Which expanded form you use will depend on the grade level. Notice, in any case, that it shows us the building blocks for each position.

Keep in mind I can keep adding powers of ten (or 0's) and get as big as I want, or I can add a decimal point and go down to tenths (10^{-1} or 0.1), hundredths (10^{-2} or 0.01), thousands (10^{-3} or 0.001), etc., which are just smaller powers of 10.

Our number system is also a base 10 number system, because as you go up each place value you multiply by ten (as you go down, you divide by 10).

Base 10 Blocks

One common model for base 10 numbers is to use **Base 10 Blocks**.

There are blocks for ones, tens, hundreds, and thousands. The idea can be extended, but those are the most common ones used.

Ones: commonly called **units**. Really just a single cube.

Figure 1: Unit
https://openclipart.org/detail/204860/decimal-system-1
CC0 1.0

Tens: commonly called **longs**. Ten units connected.

Figure 2: Long
https://openclipart.org/detail/204859/decimal-system-10
CC0 1.0

Hundreds: commonly called **flats**. Ten longs connected.

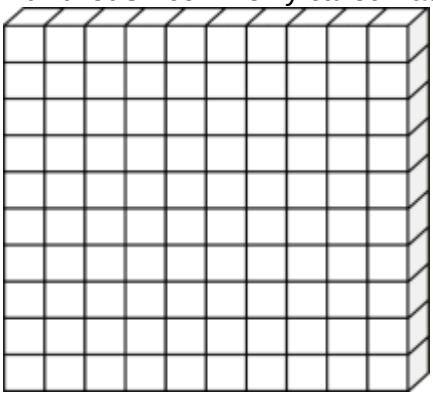

Figure 3: Flat
https://openclipart.org/detail/204858/decimal-system-100
CC0 1.0

Thousands: commonly called **blocks** or **cubes**. Some resources make a flat printable version called a **long flat** (10 flats connected in a line). Ten flats stacked.

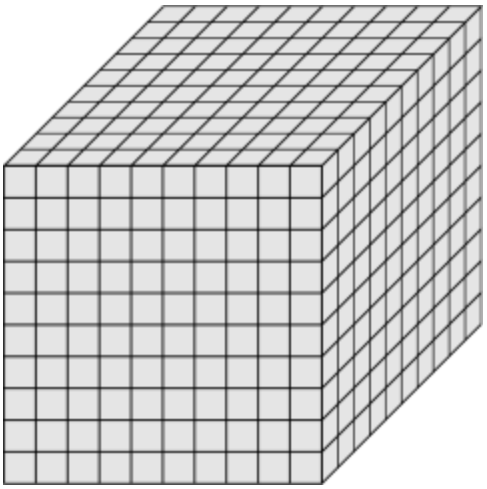

Figure 4: Cube
https://openclipart.org/detail/204857/decimal-system-1000
CC0 1.0

You can extend the idea: the next size up would be ten blocks stacked together (block long?), then ten of those (block block?), etc.

To represent a number using base 10 blocks, you simply include the same number of each type as block as the digit associated with that place value.

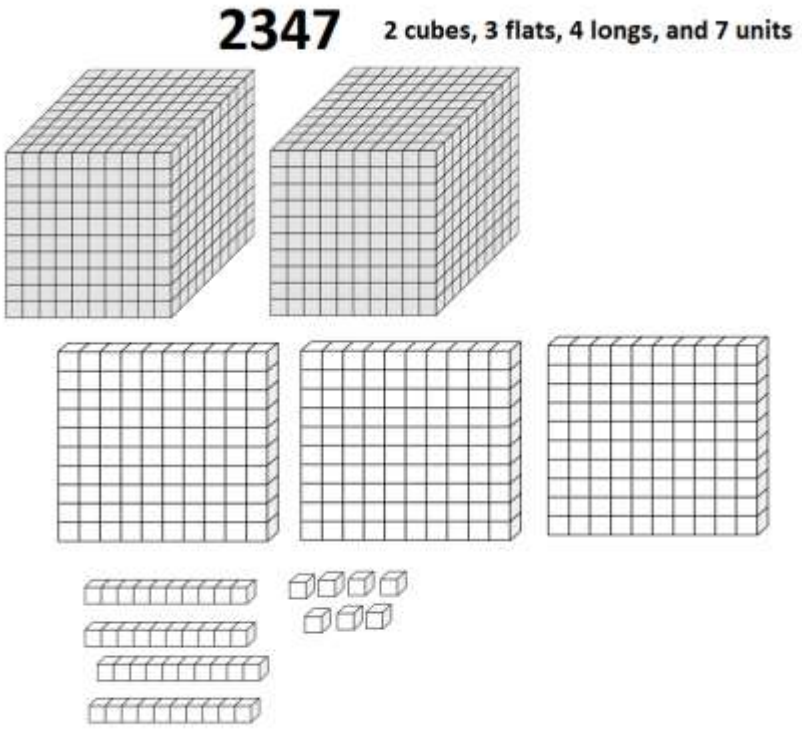

Figure 5: 2347 in Base 10 blocks