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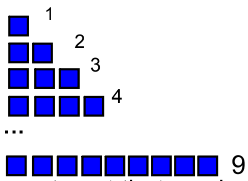
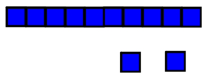
1. Base 10

Why do we call it base 10? Because we have 10 different digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Those are the ONLY digits we have. This means using just each of the digits once, we can only count up to the number 9.



Once we get past that, we have to start grouping our numbers, and use the concept of PLACE VALUE.

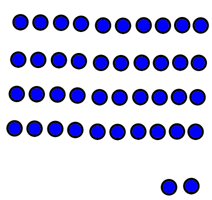


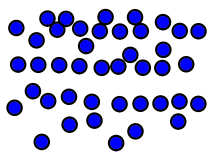
For example this number, we would write as 12. This is because there is one group of ten, and 2 loose ones.

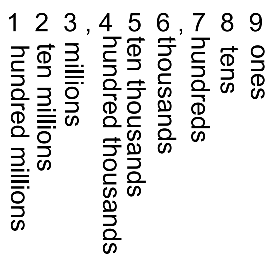
Place value means that the VALUE of a digit is determined by its PLACE in the number. For instance, in base 10, the value of each place increases by a factor of 10 as we move to the left. Each time we get to ten of something, we make a group.

1	A single one
10	Ten: A group of 10 ones
100	1 hundred: A group of 10 tens
1000	1 thousand: A group of 10 hundreds

Grouping things in this way makes it easier for us to understand big numbers. Which of these looks easier to understand?







Understanding 'base n' number systems

In base 10 we have 10 different numerals that we use: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

We group things in 10s and use the concept of place value in order to write any number at all, using only these 10 numerals.

For example in base 10 the number 348 is composed of three main parts.

3	4	8
There are 3 hundreds. A hundred is a group of 10 tens. Each ten is in turn made up of 10 ones. This is equivalent to 30 tens, or 300 ones.	There are 4 tens. A ten is a group of 10 ones. This is equivalent to 40 ones.	There are 8 ones.

But what about other base number systems? In base 2, there are only 2 numerals: 0 and 1. This means you group things in 2s.

In base 3 there would be 3 numerals: 0, 1, and 2. This means you would group things in 3s.

Fill out the following charts, counting to 10 in each number system. Just as above, explain each place value in each number. The first few are done as examples:

(pictorial representation)	Base 10	Base 2
	0	0
I	1 1 one	1 1 one
II	2 2 ones	10 1 two, and 0 ones
III		
IIII		
IIIII		
IIIIII		
IIIIIII		
IIIIIIII		
IIIIIIIII		
IIIIIIIIII		

(pictorial representation)	Base 3	Base 4
	0	0
I	1 1 one	1 1 one
II	2 2 ones	2 2 ones
III	10 1 three, and 0 ones	3 3 ones
IIII		10 1 four, and 0 ones
IIIII		
IIIIII		
IIIIIII		
IIIIIIII		
IIIIIIIII		
IIIIIIIIII		

(pictorial representation)	Base 5	Base 6
	0	0
I	1 1 one	1 1 one
II	2 2 ones	2 2 ones
III		
IIII		
IIIII		
IIIIII		
IIIIIII		
IIIIIIII		
IIIIIIIII		
IIIIIIIIII		

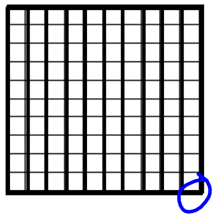
2. Powers of Ten and Base 10

Let's remember how exponents work for a minute.....

multiplying by 10 ↑

10^3 = 10 x 10 x 10		= 1000
10^2 = 10 x 10		= 100
10^1 = 10		= 10
10^0 =	1	= 1
10^{-1} =		= $\frac{1}{10}$ = .1
10^{-2} =		= $\frac{1}{100}$ = .01
10^{-3} =		= $\frac{1}{1000}$ = .001

↓ dividing by 10



Because our system is a base 10 system, there are a lot of neat things that happen when we are using exponents with tens. Let's see if we can find a pattern:

5 x 10^3	= 5 x 1000	= 5000
5 x 10^2	= 5 x 100	= 500
5 x 10^1	= 5 x 10	= 50
5 x 10^0	= 5 x 1	= 5
5 x 10^{-1}	= 5 x .1	= .5
5 x 10^{-2}	= 5 x .01	= .05
5 x 10^{-3}	= 5 x .001	= .005

As we have a base 10 system, each power of ten corresponds to a place value.

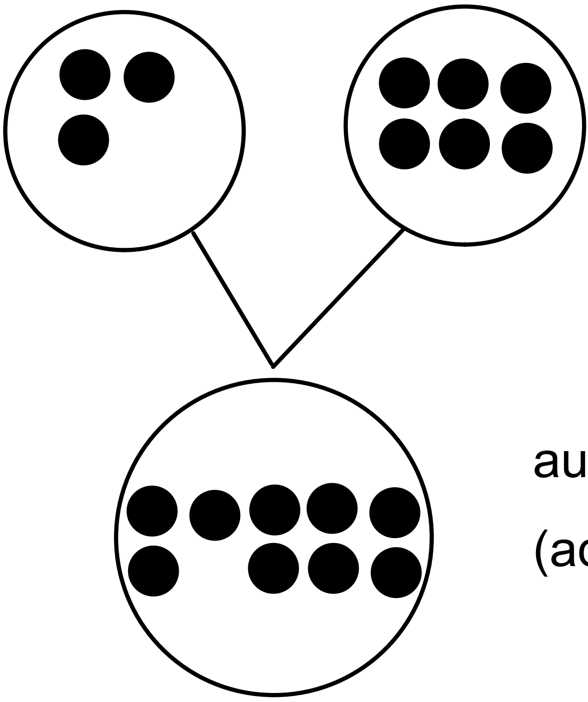
This means multiplying by a power of ten will change the place value of the number.

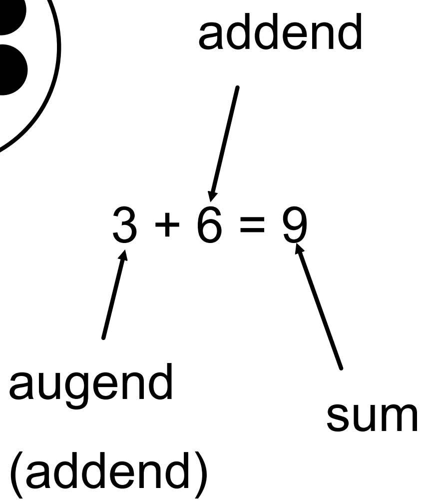
25 x 10^2	= 25 hundreds =	2500
25 x 10^1	= 25 tens =	250
25 x 10^{-1}	= 25 tenths =	2.5
25 x 10^{-2}	= 25 hundredths =	.25

In these cases we are multiplying each part of the number (20 and 5) by the power of 10. Thus, we will change where they lie in regards to the decimal point (we have altered their place value).

2. Addition

Addition is COMBINING





When we add two or more numbers, our answer is called the SUM. The parts are called addends. To be more specific, the first part is called the augend and the others addends, but we will just call them both addends.

addition is commutative:

6 + 2 = 2 + 6

addition is associative:

(3 + 4) + 5 = 3 + (4 + 5)

EXAMPLES BOOK

You should have a page of examples of finding scale ratios. As many did not yet have their books at this point I will not *require* that this be in your examples book. If you have it I will give you an extra few points.

Dissecting a number:

73,456

7 ten thousands = 7 x 10000 = 7 x 10^4

3 thousands = 3 x 1000 = 3 x 10^3

4 hundreds = 4 x 100 = 4 x 10^2

5 tens = 5 x 10 = 5 x 10^1

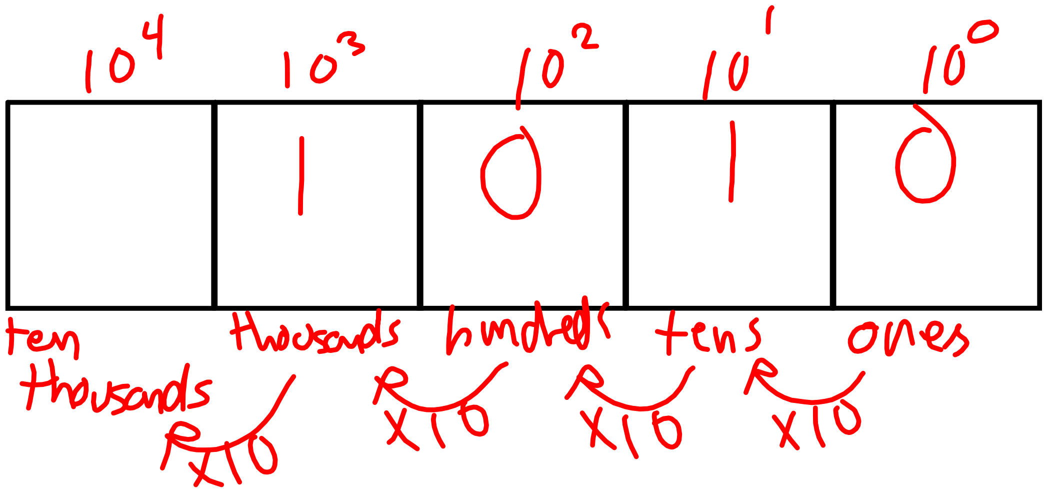
6 ones = 6 x 10 = 6 x 10^0

Base 10:

Group in tens!

Each place value is a multiple of 10

1010



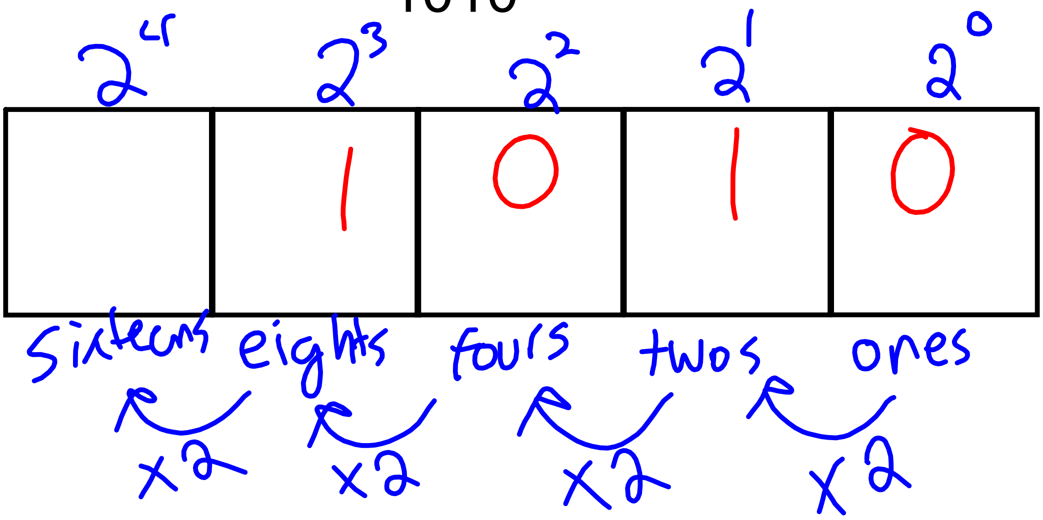
Base 2:

Group in 2s!

I only have 0, 1

Each place value is a multiple of 2

1010



Represent each part of this number with hashmarks...

22

2×10^1	2×10^0

222

2×10^2	2×10^1	2×10^0

2222

2×10^3	2×10^2	2×10^1	2×10^0

8 + 8=

7 + 5 =

6 + 8 =

$5 \times 10^3 + 4 \times 10^2 + 9 \times 10^0 =$

$5 \times 10^1 + 3 \times 10^2 + 8 \times 10^{-1} + 3 \times 10^0 =$

$4 \times 10^3 + 7 \times 10^{-2} + 5 \times 10^2 + 4 \times 10^0 =$

Abusing the ability to break apart numbers, and the commutative and associative properties of addition:

19 + 4 =

46 + 8 =

55 + 7 =

48 + 8 =

52 + 9 =

63 + 8 =

54 + 8 =

67 + 5 =

29 + 6 =

83 + 9 =

66 + 8 =

45 + 7 =

24 + 9 =

77 + 6 =

38 + 6 =

12 + 9 =