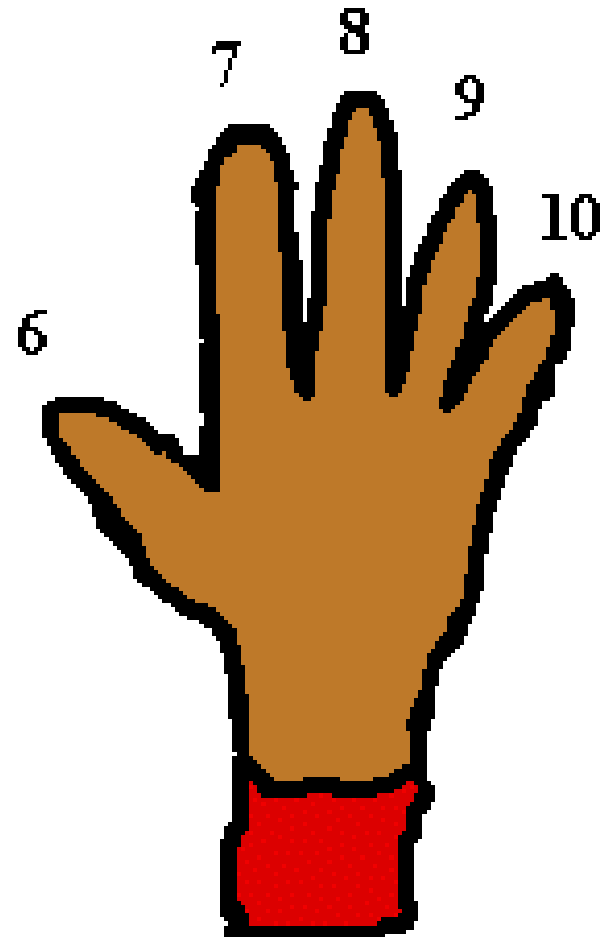
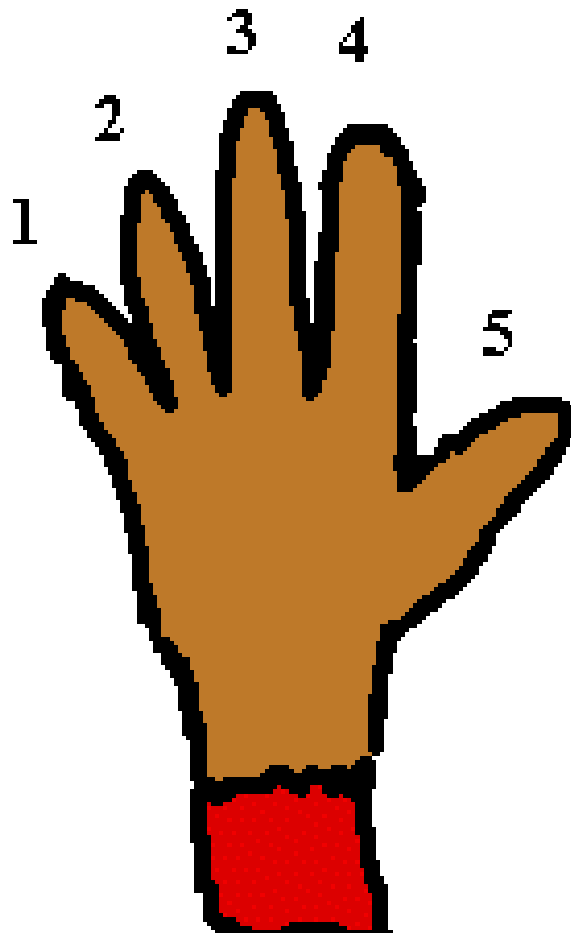


BINARY NUMBERS

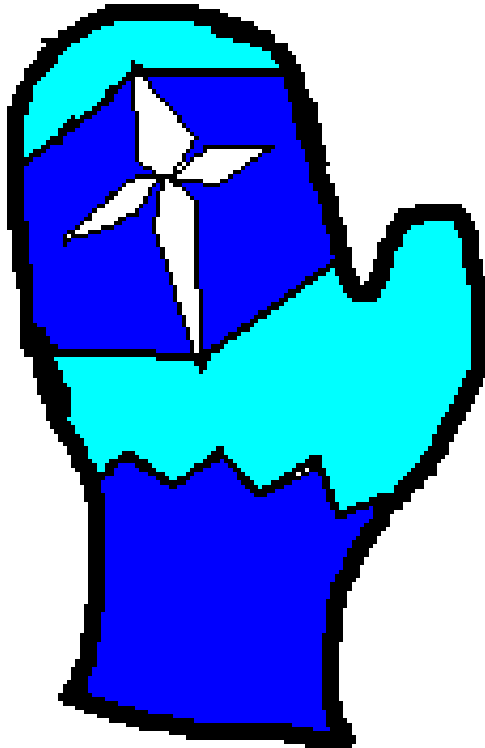
Counting in binary

"Binary" is another name for base 2.
When you learned to count, you probably counted on your fingers like this:

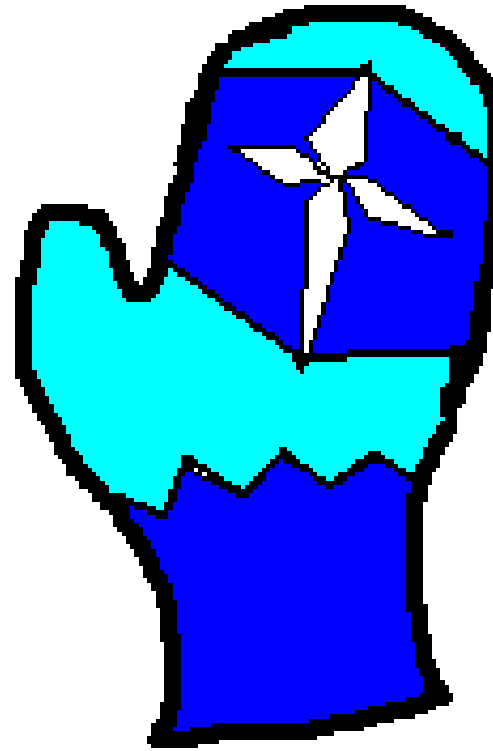


When you count as we usually do, in base 10, you have 10 different digits to use (guess what--the word "digit" has two meanings--"finger" and "numeral"!) Now imagine living in a very cold place, maybe near the Arctic circle, and wearing mittens all the time. Then you might have learned to count like this:

1



10



**You have only two digits to choose from,
0 or 1.**

The number 5986 means "5 in the thousands place, 9 in the hundreds place, 8 in the tens place, and 6 in the ones place."

$$5 \times 1000 + 9 \times 100 + 8 \times 10 + 6$$

The place values in the base 10 numbers you are used to are the powers of 10: 1, 10, $10 \times 10 = 100$, $10 \times 10 \times 10 = 1000$, etc.

The binary number 111001 means "1 in the thirty-twos place, 1 in the sixteens place, 1 in the eights place, 0 in the fours place, 0 in the twos place and 1 in the ones place".


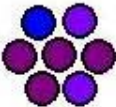



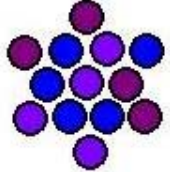


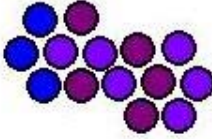




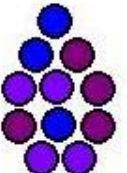

$$1 \times 32 + 1 \times 16 + 1 \times 8 + 0 \times 4 + 0 \times 2 + 1$$

The places in binary are the ones place, the twos place, the fours place, the eights place, the sixteens place, etc. That is, the powers of 2: 1, 2, $2 \times 2 = 4$, $2 \times 2 \times 2 = 8$, $2 \times 2 \times 2 \times 2 = 16$, etc.

To get the decimal (base 10) equivalent of 111001 you add up the powers of 2:

$$**1x32 + 1x16 + 1x8 + 0x4 + 0x2 + 1 = 57**$$

One to sixteen in binary

	1	1		7	111		12	1100
	2	10		8	1000		13	1101
	3	11		9	1001		14	1110
	4	100		10	1010		15	1111
	5	101		11	1011		16	10000