Binary Beading ANSWER KEY

Answer the following questions to help you further understand binary.

Remember that binary digits are either off (0's) or on (1's). You add up all the digit values for the 1's to get the regular number (base 10). The digits are as follows:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

Example: 01001101

$2^6 + 2^3 + 2^2 + 2^0 = 64 + 8 + 4 = 76$

We can compare this to a similar table for regular numbers (base 10). With base 10 we have to multiply the digit we have by the value of the location.

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0
10,000,000	1,000,000	100,000	10,000	1,000	100	10	1

Example: 3701

$$3 * 10^3 + 7 * 10^2 + 1 * 10^0 = 3 * 1000 + 7 * 100 + 1 * 1 = 3000 + 700 + 1 = 3701$$

1. Convert the binary number of 10010110 to base 10

$$\mathbf{2^7 + 2^4 + 2^2 + 2^1 = 128 + 16 + 4 + 2 = 150}$$

2. Convert the base 10 number of 153 to binary

$$\mathbf{128 + 16 + 8 + 1 = 2^7 + 2^4 + 2^3 + 2^0 = 10011001}$$

3. Look at your ASCII table. What is the difference (subtraction) between the lower case and capital letters?

The difference is 32 or $\mathbf{2^5}$

4. Look at your ASCII table. What do you notice about the binary versions of lower case and capital letters? Are they similar to each other? What is different?

Lower case and upper case are almost identical except that the lower case letters have a 1 in the $\mathbf{2^5}$ place value.

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5. Use your ASCII table to decipher this secret message.

01011001 01101111 01110101 00100000 01100001 01110010 01100101 00100000
Y o u (space) a r e (space)

01100001 01101101 01100001 01111010 01101001 01101110 01100111 00100001
a m a z i n g !

6. Write todays date in binary. Use the MM/DD/YY format.

Answer will be dependent on when you do this activity.

7. Go online to binary.onlineclock.net and see if you can tell the time. A circle indicates that position is on and no circle indicates it is off. You can also clock on the link that says "Binary Time" to see the time written in 0's and 1's. What do you notice after watching the time changing?

Answers may vary but will hopefully be something about counting patterns in binary.

8. See if you can add the two binary numbers together without converting them to base 10. (This is a very difficult problem)

101101

\+ 011011

The key to this problem is to realize binary only has two digits. We operate the problem the same way we would add in base 10 but instead of carrying when we get to 10 we carry when we get to 2.

The far right 1's add to 2 so we put a 0 at the bottom and carry a 1.

The carried 1 and the 1 from the bottom number add to 2 so we write a 0 and carry a 1.

The carried 1 and the 1 from the top number add to 2 so we write a 0 and carry a 1.

The carried 1 and the 1's from the numbers add to 3 so we write a 1 and carry a 1.

The carried 1 and the 1 from the bottom number add to 2 so we write a 0 and carry a 1.

The carried 1 and the 1 from the top number add to 2 so we write a 0 and carry a 1.

We end up with 1001000 which is 72 in base 10.