

RAFT IDEAS

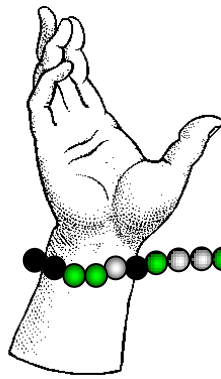
Topics: Binary Numbers, Place Value, Exponents, Number Bases

Materials List

- ✓ Pony beads of 3 different colors
- ✓ Cord, string, or equal

This activity can be used to support the teaching of: Common Core Math Standards:

- Factors (Grade 4, Operations and Algebraic Thinking, 4)
- Place Value (Grade 4, Number and Operations in Base Ten, 1; Grade 5, Number and Operations in Base Ten, 1 & 2)
- Exponents (Grade 6, Expressions and Equations, 1)
- Problem Solving and Reasoning (Mathematical Practices Grades 4-12)



Binary Birthday Bracelets

Encode a Date of Birth into a Wearable Band!

June 19th, 2000



Learning about binary numbers (Base 2) incorporates number sense, exponents, and the conversion of numbers between different bases. Binary numbers are essential to the functioning of common digital electronic devices but are usually well hidden!

To Do and Notice

1. Demonstrate how to change a base 10 number into a base 2 (binary) number. A way to do this is listed below the table. See **Web Resources** for other methods. For a good practice activity see RAFT Idea Sheet *Binary Dots*.
2. Pick 3 bead colors to represent “0”, “1”, and “space”. A **single** space bead is put between the numbers. A **pair** of “space” beads is used to indicate the starting point.
3. Encode a birthday, or birth date, into “0’s” and “1’s” using an appropriate method.
4. Collect the necessary number of each type of bead for “0’s”, “1’s”, and “spaces”.
5. Decide on the date format (MM-DD-YYYY or DD-MM-YYYY).
6. Cut a cord, or equal, into lengths suitable for a bracelet.
7. String the beads onto the cord with a single space bead between each number plus 2 space beads for the starting point of the date.
8. Tie the ends together so that the beads can not slip past the knot.

The Math Behind the Activity

Base 10	2^{10} (1024)	2^9 (512)	2^8 (256)	2^7 (128)	2^6 (64)	2^5 (32)	2^4 (16)	2^3 (8)	2^2 (4)	2^1 (2)	2^0 (1)	Base 2 (binary)
6									1	1	0	110
19							1	0	0	1	1	10011
2000	1	1	1	1	1	0	1	0	0	0	0	11111010000

To change a number from base 10 to base 2, determine which numbers in the first row from the table above add up to the desired base 10 number. In the case of 19, the combination is 1 from the 2^4 column, 1 from the 2^1 column, 1 from the 2^0 column, and none from the 2^3 and 2^2 column ($16+0+0+2+1=19$). So 19 in base 10 is “10011” in base 2. As with base 10 numbers, the “0” is placeholder.

A subscript number can be added to a number to indicate which base number system is being used. For example $19_{10} = 10011_2$.

People in technological societies deal daily with binary numbers but this usually goes unnoticed. Binary numbers encode and store the information on credit cards, computers, digital recorders, and the UPC barcodes found on all consumer products. Base 2 numbers are ideally suited to be represented by electrical & magnetic systems that can provide 2 distinct conditions, such as a switch which is either on or off.

Taking It Further

Students could do addition and subtraction problems using binary numbers.

Web Resources (Visit www.raft.net/raft-idea?isid=299 for more resources!)

- Converting decimal to binary - <http://www.bellaonline.com/articles/art31011.asp>
- For more information on binary, visit: <http://mathworld.wolfram.com/Binary.html>