RAFT IDEAS

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

Materials List

- ✓ Pony beads (3 colors)
  -"1" color (blue)
  -"0" color (red)
  -"Space" color (white)
- ✓ String, cord or chenille stem about 25 cm – 30 cm (10"-12") long

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 & 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)

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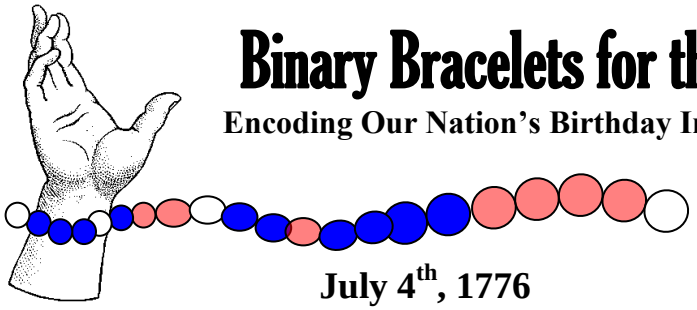

Binary Bracelets for the 4th of July

Encoding Our Nation's Birthday Into Wearable Bands

July 4th, 1776

Learning about binary numbers (Base 2) builds an understanding of number sense, exponents, and different base number systems. In making a Binary Bracelet for the 4th of July, students will encode our nation's birthday into a wearable bracelet.

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. Indicate which bead colors will represent "0", "1", and the "space" between the month, day, and year numbers. (red = "0"; blue = "1"; white = "space")
3. Challenge the students to encode July 4th, 1776 (Independence Day) in binary using these beads. Students can string the beads onto a chenille stem, which is the right length for a bracelet. The month is encoded on the end opposite the 11 digit year.

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)
July									1	1	1	111
4th									1	0	0	100
1776	1	1	0	1	1	1	1	0	0	0	0	11011110000

To change a base 10 number into a base 2 number find the largest number in parentheses above that is **less than or equal to** the base 10 number. Put a "1" in that column. Subtract the column number from the base 10 number. Take the remainder, if any, and repeat the process until the remainder is zero. For the number 7, 7 – **4** = 3; 3 – **2** = 1; 1 – **1** = 0 giving "111". Put a "0" in any empty columns to the right of the left most column that has "1" in it. Adding column numbers, in parentheses, that have a "1" will equal the base 10 number. For example, **1776 = 1024 + 512 + 128 + 64 + 32 + 16.**

People in technological societies deal daily with the binary number system, but this usually goes unnoticed. Binary numbers encode and store information on credit cards, computers, digital recorders and the UPC bar codes found on all consumer products. Base 2 numbers are ideally suited for being easily represented by the two conditions found in electrical (on/off) and magnetic systems (north/south pole orientation).

Taking it Further

Students could encode their own birthday and/or their age into a personalized bracelet. See RAFT Idea Sheet ***Binary Birthday Bracelets***.

Web Resources (Visit www.raft.net/raft-idea?isid=301 for more resources!)
For more information on base 2 and other math topics visit:
http://mathworld.wolfram.com/Binary.html

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