RAFT IDEAS

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

**Materials List**
- ✓ Weaving board
- ✓ Beads of two colors
- ✓ String or cord
- ✓ Ascii alphabet

This Activity can be used to support the teaching of:
- Number Sense and Place Value (Grades 4 and above)
- Exponents (CA Math Standards: Number Sense, Grade 5, 1.4; Grade 7 2.1; HS Algebra 2.0)
- Bases (CA Math Standards: Number Sense, Grade 7, 2.1)
- Exponential Growth (CA Math Standards: HS Probability and Statistics, 4.0)

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# Binary Weaving

Breaking the Computer Code

Computers use binary numbers (Base 2), a series on "ons" and "offs" that encode information. In this activity, students use the Ascii alphabet to encode a message into woven band, and then other students can decode the information.

## To Do and Notice

1. Introduce students to the binary system and the Ascii alphabet (either include the binary number or let the students figure them out.)
2. Direct the students to choose one bead color to represent "0" (off) and another to represent "1" (on).
3. Challenge the students to encode a secret message in binary using beads. This could be a Native American-style band eight beads wide, or a very long string of single beads.
4. Have students switch their beaded creations with classmates to decode.

## The Math Behind the Activity

| | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|
| Base 10 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| L = 76 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| i = 105 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |

Computers use the binary system (base 2) because it can be transmitted electronically, through "offs" and "ons". A number has been assigned to each capital letter, lower-case letter, and punctuation mark. To translate a number to binary, go through the following steps:

**Turning 76 into binary:**
- Can you subtract 128 from 76 and get a positive number? No. Place a 0 in the $2^7$ column.
- Can you subtract 64 from 76 and get a positive number? Yes. Place a 1 in the $2^6$ column.
  - Subtract 64 from 76 (76-64=12)
  - Continue process with remaining number = 12
- Can you subtract 32 from 12 and get a positive number? No. Place a 0 in the $2^5$ column.
- Can you subtract 16 from 12 and get a positive number? No. Place a 0 in the $2^4$ column.
- Can you subtract 8 from 12 and get a positive number? Yes. Place a 1 in the $2^3$ columns.
  - Subtract 8 from 12 (12 - 8 = 4)
  - Continue process with remaining number = 4
- Can you subtract 4 from 4? Yes. Place a 1 in the $2^2$ column.
  - Subtract 4 from 4 (4 - 4 = 0)

  **Once 0 is reached, place a "0" in all remaining columns.**

Developed and written by Coral Clark (RAFT)

# Ascii Alphabet

**American Standard Code for Information Interchange**

| Symbol | Decimal | Binary | Symbol | Decimal | Binary |
|---|---|---|---|---|---|
| A | 65 | 01000001 | a | 97 | 01100001 |
| B | 66 | 01000010 | b | 98 | 01100010 |
| C | 67 | 01000011 | c | 99 | 01100011 |
| D | 68 | 01000100 | d | 100 | 01100100 |
| E | 69 | 01000101 | e | 101 | 01100101 |
| F | 70 | 01000110 | f | 102 | 01100110 |
| G | 71 | 01000111 | g | 103 | 01100111 |
| H | 72 | 01001000 | h | 104 | 01101000 |
| I | 73 | 01001001 | i | 105 | 01101001 |
| J | 74 | 01001010 | j | 106 | 01101010 |
| K | 75 | 01001011 | k | 107 | 01101011 |
| L | 76 | 01001100 | l | 108 | 01101100 |
| M | 77 | 01001101 | m | 109 | 01101101 |
| N | 78 | 01001110 | n | 110 | 01101110 |
| O | 79 | 01001111 | o | 111 | 01101111 |
| P | 80 | 01010000 | p | 112 | 01110000 |
| Q | 81 | 01010001 | q | 113 | 01110001 |
| R | 82 | 01010010 | r | 114 | 01110010 |
| S | 83 | 01010011 | s | 115 | 01110011 |
| T | 84 | 01010100 | t | 116 | 01110100 |
| U | 85 | 01010101 | u | 117 | 01110101 |
| V | 86 | 01010110 | v | 118 | 01110110 |
| W | 87 | 01010111 | w | 119 | 01110111 |
| X | 88 | 01011000 | x | 120 | 01111000 |
| Y | 89 | 01011001 | y | 121 | 01111001 |
| Z | 90 | 01011010 | z | 122 | 01110010 |