BITS
Teaching Guidelines

Subject: Mathematics

Topics: Algebra

Grades: 6 - 12

Concepts:

- Exponent

Knowledge and Skills:

- Can translate a mathematical relationship described in words into an expression, equation or inequality

Procedure: This project should be done by students individually or teams of two.

Distribute the handout. You may wish to discuss the examples on the first page as a class before having students work individually or in teams to answer the questions on the second page.

Answers

Equation: $c = 2^n$

Number of bits	Number of shades
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
24	16,777,216

Bits

Computers, and most modern communication systems, work with information that is in digital form—that is, information which has been converted into a stream of 0's and 1's.

In this investigation you will find out more about how an image, such as a photograph or a drawing, can be converted into 0's and 1's. Each "0" and "1" is called a bit of information.

An image can be thought of as a collection of very small dots, of different colors. To keep things simple, we're going to investigate only black and white images, where all of the dots are black, white or a shade of gray.

Suppose we use one bit of information to represent the shade of a dot. That one bit can be either a "0" or a "1", and so we can represent two shades:

Black:	0
White:	1

If we have two bits, then there are four possible combinations: 00, 01, 10, and 11. In that case, we could have four shades:

Black:	00
Dark gray:	01
Light gray:	10
White:	11

If we have three bits, there are eight different codes, so we could have eight different shades of gray.

000	100
001	101
010	110
011	111

1. Make a list of all possible combinations of 0's and 1's in four bits of data. How many different shades can be represented with 4 bits of color?

   Number of shades: _____

2. Use the data we have gathered so far to fill out the chart below.

Number of bits	Number of shades of gray
1	2
2	4
3	8
4	
5	
6	
7	
8	

3. Continue the investigation to find the number of shades that can be represented with 5 bits and 6 bits of information. Add that information to the chart.

4. Look for a pattern in the chart. Use it to determine how many shades of color can be represented with 8 bits of information.

   Number of shades: _____

5. How many shades of color (c) can be represented with **n** bits of information? Write this as an equation.

   Equation: _____

6. On some computer systems, 24 bits of information are used to represent the color of each dot in an image. Use your equation to determine how many different colors can be represented with 24 bits of information.

   Number of shades: _____